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[SECOND SERIES.]

ART. XIV.—*Notice of Baron Wolfgang Sartorius von Waltershausen's work on Mount Etna;* by J. L. HAYES.

THE interest which attached to Etna in ancient times, when burning mountains were considered rare and accidental phenomena, and nearly all that was known of volcanic agency was derived from an observation of this remarkable mountain, has been in no respect diminished by modern discoveries, which have so much enlarged the sphere of igneous action, and have shown that those mysterious phenomena which were apparent exceptions to the harmony of nature, are necessary parts of the great machinery of the earth; for as our conceptions of the importance and magnitude of volcanic agency are enlarged, the more interesting is the theatre where its operations are best displayed.

The volcano is the point of departure to the geologist in his investigations of the most ancient revolutions of the globe. It repeats in his own times the phenomena of the disturbance and elevation of mighty masses of the earth's crust. It spreads before his eyes beds of crystalline rock, analogous to those formed in ancient periods. It exhibits a power still at work, which is inherent to the nature of the earth, and must have been active during its earliest epochs. But above all other volcanoes, and we may say above any other known point on the earth's surface, Etna is full of instruction to the geologist, as well as delight to

all who would observe the terrible and beautiful in nature. The majesty of its proportions—the individuality, if we may so speak, of its form—the frequency and terrible effects of its eruptions, displaying every form of activity, in the flow of lava currents, the formation of lateral cones, and the uplifting of the solid basis of the mountain—the light which its internal structure throws upon some of the most difficult questions of volcanic geology—the fullness and authenticity of its history, going back to a more remote epoch than that of any other volcano, make Etna, the classic volcano, and its phenomena, types of all that is curious and wonderful in the most sublime agency of nature.

Etna has never been without its observers from the time of Pindar, who described it with such graphic skill. Notwithstanding the details respecting its structure and phenomena, presented in the works of the Sicilian savans, Recupero, Ferrara and Gemmellaro, whose lives were passed at the foot of the mountain, new and important facts have been made known by foreigners whose opportunities for observation have been limited, and particularly by Dolomieu, Spallanzani, Hamilton, Scrope, Hoffman, Abich and Lyell. The observations made by Elie de Beaumont in 1834, during a visit of only a few days, have thrown a flood of light upon the structure of this mountain, and seem almost to have resolved the great question as to the mode of elevation of the volcanic piles. But even this most acute observer acknowledges that all the materials for the construction of an edifice whose achievement would present the first interest to science, could not be condensed into a complete work, except by one who should make a prolonged sojourn upon the places to be described. Indeed nothing less than a faithful picture of this portion of the crust of the globe, founded upon all the observations of former explorers, prepared with all the appliances of modern science, and illustrated by the highest art, could satisfy the curiosity with which this remarkable spot is regarded.

These considerations will enable us to appreciate the service which has been done to science by the labors of a German savan, Baron von Waltershausen, who has finished and is now presenting to the world a complete history of Etna and its convulsions.

A brief personal sketch will convey the best idea of his fitness for the great work which he has undertaken, and lead us naturally to an account of his scientific labors.

Baron Wolfgang Sartorius von Waltershausen, now about 37 years old, was born in Göttingen. His father, a corresponding member of the French Institute, and a representative of one of the German States at the Congress of Vienna, is still well known on the continent of Europe as the author of an important and learned history of the Hanseatic cities and their league. From the intimacy existing between Göthe and the family of Baron Waltershausen, that great poet was his godfather, and gave him his own name, John Wolfgang. He was educated chiefly at the University of Göttingen, where his father was for some years a professor, lecturing with great reputation on History and Political Science, and refusing from his attachment to the place and its resources, frequent offers that were made to him of higher positions in the service of Russia and other German States.

But the son so far as intellectual occupation was concerned, showed no disposition to follow in his father's footsteps. From his earliest youth he discovered a passion for the study of nature, and especially of mineralogy and geology. When hardly seven years old, in a childish letter to a friend of the family, a distinguished scholar of this country, who was about to visit Italy, he said, "I am making a collection of mineral stones, and I wish I had some lava. If you go to Naples, pray send me a piece from Vesuvius." The passion thus early developed grew with his years, and after the death of his father, who died in his arms in 1828, and that of his mother, a lady of some accomplishments and personal attractions, which followed two or three years later, he found himself still young, in possession of a good fortune, and free to devote himself to the pursuit of his favorite sciences. His determination was at once taken, and he prepared himself by the most careful study, and by personal investigation of the mineralogy and geology of Germany, for the enquiries that he intended to make elsewhere.

He was satisfied however, that in order to do any thing for the advancement of the sciences to which he now devoted his life, he must avoid the common fault of extending his researches over too wide a field. After much consideration therefore, he selected a single point, Etna and its neighborhood, as the scene of his labors, determining to remain there until he should have accomplished whatever in the present state of knowledge could be undertaken for the explanation of its extraordinary phenomena,

As soon then as he could make the large arrangements necessary for his undertaking, in 1835–6, he hastened to Sicily, carrying with him such draftsmen, surveyors and other assistants as could be useful. He was delighted with the region so admirably chosen for enquiries intended to enlarge the boundaries of science, and establishing himself on the highest habitable point of the volcano, devoted himself with the greatest zeal, self-denial and perseverance to his task, until he had completed the most ample topographical and geological maps of the whole country, investigating at the same time its peculiar character with great minuteness, and preparing drawings and sketches of every thing that could illustrate his discoveries or their results.

In this great work he and his assistants spent seven years, until the "mad German," as the ignorant part of the population sometimes called him, had become as well known to the inhabitants of the island as the mountain itself.

At last in 1842, he returned to Germany, carrying with him a great work which he had completed amidst much personal exposure, peril and suffering, without support from any European government, and sustained only by the love of science and his own strong will. This work he is now publishing both in German and French, under the title of "Etna and its Convulsions." It is when completed to consist of two parts. The first part is to be an atlas folio volume of engravings, containing 1. A topographical chart of Etna and its neighborhood, drawn in the proportion of 1 to 50,000 in., from trigonometrical surveys made by himself, or under his own supervision, on 15 large folio sheets. 2. A corresponding geological map on 15 similar sheets, and 3. About 54 large engravings of views, sections and other sketches appropriate to the illustration of the whole subject; explanations of the plates accompanying each. The first number of this part of the work was published in Göttingen in 1845, and beautifully engraved by artists of much merit, one of whom, Cavallari, Baron von Waltershausen had in his service in Sicily, and took with him to Germany on account of his great skill in this particular department of topographical drawing and engraving. Five other numbers will follow at intervals of a year, making six in all, the price of each of which will be seven Spanish dollars.

The second part of the work is to consist of a thick quarto volume, containing after a general and scientific topographical introduction, the astronomical observations made to determine the localities, the base measurement and triangulation of the volcano; a minute topographical description of it; trigonometrical and barometrical observations to determine its height; an examination of its terrestrial magnetism; its mineralogy complete; a history of its eruptions from the days of the Licanians to the present time; its entire geology, with an account of its origin and of the changes it has undergone, as far as they can now be traced or recognized; and in conclusion, a discussion of the general theory of volcanoes, and a comparison of Etna with the Ligurian volcanoes, Vesuvius, and the volcanoes of the South of Europe. This part will be published as soon as it can be prepared.

This remarkable monograph, on which its author has so disinterestedly spent and is now spending the best years of his life and a large part of his fortune, is published wholly at his own expense, and without any expectation of being remunerated for his sacrifices, except by the reputation he will earn, and the consciousness of what he has done for the great cause of science and the progress of intellectual culture.

Thinking that there may be persons in this country who have a spirit like his own, and are interested in similar pursuits, he has sent, we are happy to say, a few copies of the first number of his work in French to a friend in Boston. They may be found on sale at Little & Brown's, booksellers, Boston. We need hardly mention that this is the same work of which some early specimens were presented by Hon. Nathan Appleton to the Association of American Geologists, at their meeting in Washington in 1844, and with respect to which resolutions of high commendation were passed by the Association.

Until the present time the model for labors in volcanic geology has been the elegant monograph by Leopold von Buch, the Physical History of the Canary Islands, which at the time of its appearance was justly esteemed the most beautiful geological work ever published. The highest praise that we can offer with regard to the execution of "Etna and its Convulsions," is to say that the illustrious work of the father of German geologists has been wholly surpassed by the genius and industry of his countryman.

We hope that this elegant and valuable work will find its way to the libraries of our men of science and fortune. It is a model which our best geologists and topographers may study with profit. It will exhibit to younger students in physical science, the rich rewards of concentrated and long continued labor, and it may excite some of our own countrymen to achieve among the unexplored volcanoes of the South, and on our western coast, conquests in science more glorious than those of victorious arms.

ART. XV.—*On Three several Hurricanes of the American Seas and their relations to the Northers, so called, of the Gulf of Mexico and the Bay of Honduras, with Charts illustrating the same;* by W. C. REDFIELD.

(Continued from Vol. I, p. 369.)

Review of the Phenomena and Characteristics of the Cuba Hurricane.

THE detailed observations and accounts which have now been submitted, afford us a comprehensive view of the two Cuba storms, in their daily progress, and may serve for enabling other inquirers to make a more complete analysis and generalization of the several phenomena than can be attempted on the present occasion. It will be my province to elucidate some of the more prominent facts and characteristics which pertained to these gales, and especially to the great hurricane.

TRACK OF THE STORM.—From what primary sources, or in what particular region this hurricane had its origin, or on what portion of the earth's surface it first took effect as an observable gale of wind, does not appear. Its observed route, as indicated by the foregoing recitals, appears nearly direct from the shores of Central America, crossing the islands of Cuba and Newfoundland, and may fairly be estimated as extending from Cape Honduras, lat. 16°, lon. 86°, to a point on the axis line opposite to the position of the *Independence* at noon of Oct. 8th, near lat. 50° 25′, lon. 49° 45′; which, following the axis route, exceeds *three thousand statute miles.* To what further extent this storm might be traced, does not distinctly appear.*

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* See Chart IV.

RATE OF PROGRESSION.—This may be approximately shown by the following estimate of the progress of the storm's axis,—which, so far as known, coincided nearly with the observed minimum of the barometer, at the several points of observation. We commence from a point on the axis line opposite to the *Openango*, (recital 7,) about 9·30 P. M. on the 4th of October.

From No. 7	to opposite Key West	=246	miles	in	16½	hours;	*rate*	15	miles	per hour.
" Key West	to lat. 27° 30′	=324	"	"	12½	"	"	26	"	" "
" lat. 27° 30′	to lat. 31°	=302	"	"	7	"	"	43	"	" "
" lat. 31°	to lat. 40°	=781	"	"	18	"	"	43·4	"	" "
" lat. 40°	to lat. 45°	=480	"	"	14	"	"	34	"	" "

Previous to the night of the 4th its progress may have been slower than the lowest rate here given.

(1.) We notice that while below the tropic, the rate of progression did not exceed that which has been found in several of the West Indian hurricanes moving in the same latitudes but following a widely different course. (2.) We find that a highly rapid, if not unexampled progression was acquired by this hurricane while on its course from the tropic to the usual exterior limit of the trade winds; in which region the progress of hurricanes has often been comparatively slow. Such former cases of retardation I have attempted to explain by the change from a westerly to an easterly progression; a change that does not appear in the Cuba storm. (3.) We find that the most rapid advance of this storm was from the northern border of the trade winds to the parallel of 40° or 42°; this being the region, in which, if I mistake not, the permanent currents of the lower atmosphere are commonly found in their fullest activity. (4.) We here ascertain a gradually decreasing rate of progression in the latitudes beyond 40°, which has probably occurred in other storms, and which, in connexion with other causes, may serve, in some degree, to explain or account for the extent and complication of the barometric waves and other meteorological phenomena in the higher latitudes.

The average progression of the storm from the Bahamas to latitude 45°, may be stated at forty miles per hour.

So far as is yet known, the most rapid progression has been attained by those storms which have pursued the most northerly courses, in their progress from the lower latitudes. The highest rate previously known, in the American seas, appears to have

been about thirty miles an hour; while in the case before us the rate, through perhaps twelve degrees of latitude, appears to have exceeded *forty-three miles an hour.*

The integral progression of the great storms of the lower atmosphere may be viewed as affording data of great value for any investigations of the actual course of atmospheric circulation, or of the great planetary laws by which this circulation is chiefly maintained.*

Lateral Diameter of the Storm.—In determining the full diameter or breadth of the storm, across its path, it is somewhat difficult to mark an approximate limit of its action on either side of its axis, independently of any deficiency in the observations. Thus it might be questioned whether we should test its extent (1) by the observed prevalence of an active storm-wind, at the surface only,—or (2) by the entire extent of the conformable or vorticular winds at the earth's surface,—or (3) by the presence and observed movements of the lower stratum of storm-clouds, as connected with the foregoing,—or (4) finally, by the more widely extended effects on the barometer.

We may conclude, however, that the broadest lateral extent over which the winds of this storm prevailed in observable strength at the surface, or in which the weather exhibited a stormy appearance, or effect, exceeded a diameter of nine hundred miles and perhaps equalled one thousand; while the general breadth of the *gale*, as one of ordinary, as well as extraordinary force, may be estimated as, at least, eight hundred miles.†

This last, if taken as the average width of the storm path and multiplied by the observed length of the latter, as before estimated, indicates an area of *two millions and four hundred thousand square miles*, which was swept over, with more or less violence, by this gale; an extent nearly three times greater than all the territory of the United States east of the Mississippi.

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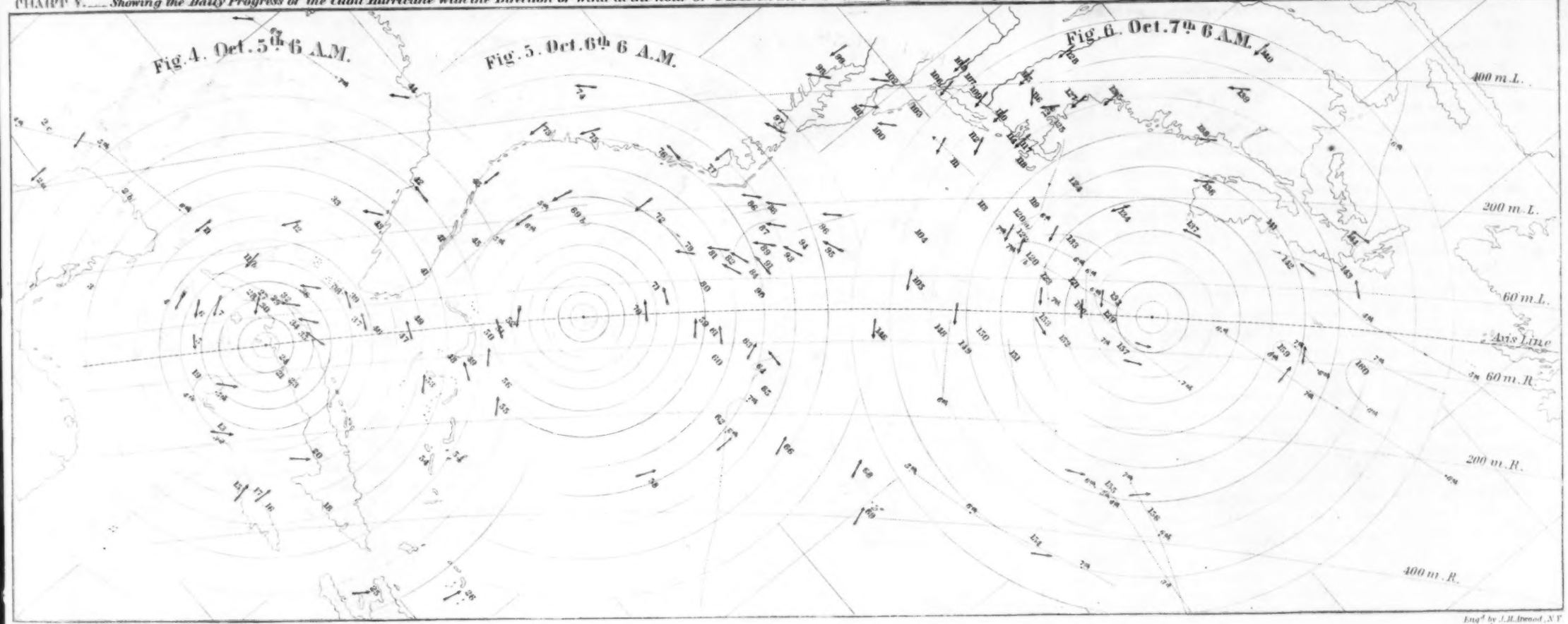
* It may be proper again to state, that the results of the author's inquiries on the courses of winds, and their relations to temperature, in different regions, and at different elevations, have constrained him to relinquish the common theory that heat is the sole or main cause of wind, or progressive motion, in a planetary atmosphere.

He has been aware of the disadvantage in which this avowal may tend to place him, in the minds of many votaries of science whose approbation it would be his happiness to obtain. The proper elucidation of this question, he conceives, will belong to the future.

† See recitals 2*a*, 2*c*, 22, 25, 26, 44, 69, 154, 99, 106, 107, &c.

CHART V.

CHART V.—*Showing the Daily Progress of the Cuba Hurricane with the Direction of Wind at the hour of 6 A.M. on the 5th 6th & 7th days of October, respectively 1844.*



Engd by J.M. Atwood, N.Y.

The numbers show the places or vessels named in the recitals.

The width of that portion of the track in which was exhibited either the violence of a hurricane or that of a severe or destructive gale may be estimated to exceed *five hundred miles.**

Diameter of the Storm on its Center Path.—The diameter of the storm-wind from front to rear might be directly determined by the distance from a point in front to another in rear at which it severally began or ended at the same time; provided that we could obtain good hourly observations which should so coincide. An available substitute for this method is found in plotting the observations for a given hour, on successive days, as on Chart IV, and the other charts which follow. Thus the distance between the two several positions assigned to the axis of the storm at noon on the 5th and 6th days of October, respectively, is 784 miles. Now the *Demarara*, (45*b*,) in front of the gale on the 5th, was brought to reefed topsails as early as 8 A. M.; while at noon on the 6th, after an advance or drift of 88 miles in the Gulf Stream, this vessel remained hove to, and did not set reefed topsails till 1 P. M.; nor let out reefs and make full sail till 6 P. M., a period of 34 hours. This authorizes an estimate of 1084 miles for this diameter of the storm as a reefed topsail gale.

The distance between the two axis positions on Chart IV for noon of the 6th and 7th, respectively, is 950 miles, and the observations of the winds and minimum of the barometer on board the *Pique* frigate appear to show that the storm figure for noon of 7th should have been placed thirty miles further in advance, making the distance between the two axial points equal to 980 miles. Now, even at Bermuda the strength of the gale was marked 6 at two hours before noon of 6th; and, more in front, the gale was strong with the *Wakulla* (148) at noon, and continued to blow a gale till noon of the 7th. These facts indicate a diameter of more than a thousand miles. These estimates include neither the incipient nor the closing moderate and light winds which were conformable with the body of the gale.

Another good estimate of the diameter in this direction is obtained by multiplying the rate of progress by the whole duration of the storm wind, at the several points where the observations have been most complete. If we apply this to the entire observations at Key West, (38,) about 48 hours, with an *average* rate

* Recitals 11, 20, 66, 118, 136, 156, and others.

of 15 miles for the first 26 hours, and of 32 miles for the last 22 hours, we have 1094 miles for this diameter. The like estimate applied to the observations on board the *Demarara*, (45*b*,) with the increased rates of advance, and deducting the vessel's progress, will give a result fully equal to the foregoing. These conclusions may be sustained, also, by a like reference to the recitals mentioned below.*

These results cannot be invalidated by the reports which are less determinate, nor by those which refer only, or chiefly, to the more violent portion of the gale. They are satisfactorily tested by the fact that the daily advance of the gale, which from lat. 27° to 42° was equal to 1032 miles per day, does not, in all cases, afford space on the chart sufficient for the separate daily delineation of all the observations of the earliest and latest wind of the storm.

We may hence conclude that the entire extent of the gale on its line of progress was somewhat greater than its lateral diameter; unless we admit that, on its southeastern border, the gale was extended much beyond our points of observation on that side. Its limitation on the left or continental side, owing probably to the obstructions and elevations of the surface and the pressure of the natural currents from the western board, is more distinctly determined.

The diameter of the violent portion of the gale, in the direction of its progress, does not appear to have been less than in the transverse direction.†

Revolving Character of the Storm-Wind.—As regards the general manner in which the wind was exhibited in this case, as well as in other great storms, I can find no ground for the support of opposite or dissimilar conclusions.

On a general review of the observations, the following state of facts is presented to our notice. (1.) In the early part or front of the storm, on its centre path, we find the wind to have blown from the southeastern quarter, transversely from the right towards the left side of the path. Continuing to follow this wind in its course, as we depart from the axis path the observations show it to proceed successively from more eastern and northeastern points,

* Nos. 72, 86, 100, 118, 121, 123, 129, 130, 141, 142, 144.

† This will be seen on an examination of the data presented in cases 35, 38, 64, 70, 71, 121, &c.

till, on the passing of the gale's axis, it has veered so far to the left as to blow from northern and northwestern points of the horizon, thus turning gradually towards the center path, and, finally, recrossing it, in the rear of the storm's axis, on the fair-weather or clearing-up side. See observations in Table I; which follows. We find, indeed, in some localities, that a portion of the successive changes in the wind's direction have occurred somewhat suddenly, or with some irregularity, but this will not invalidate the general result of the observations.

(2.) If now we place ourselves again in the front of the storm, on its center path, and follow *back* the first southeasterly wind towards its apparent source on the right hand side of the storm path, the observations will show, that as we recede from the axis line and the storm advances, the wind comes, successively, from points more and more southward or southwesterly, till, on the passing of the gale's axis, it comes from points successively more westward and leading us again towards the axis line, on the posterior side of the storm, till, finally, we find ourselves in the same northwesterly wind from which we had parted at the end of our first semi-circuit of the gale. See the successive observations in Table III.

In thus tracing the circuit of the wind, on the two sides of the storm-path, we have followed the order in which the wind's changes are severally presented to observers. We have seen that these changes have been in *opposite courses of succession*, on the opposite sides of the axis path, viz. from the right towards the left, on the left hand side of the path, and from the left towards the right, on its right hand side. But if we follow out our first trace continuously round the circuit, from the rear to the front of the storm on its right side, being the constant direction from right to left, ↻, we shall then follow the wind in its own order of progress, which is the *reverse* of the order in which its successive changes are always presented to observers on this right hand side of the axis route, by the advance of the storm over the places of observation.

It is evident, therefore, that observers in the *right* side of a storm, in this hemisphere, have the changes of wind presented in a *backward* or reversed succession; while with those on the left side of the path the succession of changes is a forward one, coinciding with the order of the wind's rotative progress.

(3.) In accordance with the foregoing facts, we find that the observed changes in the wind's direction were most rapid or sudden in places nearest to the axis of the gale. On and near the axis path the southeasterly wind, first mentioned, was found to continue without much change of direction as the storm advanced, until the approach of the axis; when, commonly after an axial lull or remission, a change to the opposite quarter took place, more or less sudden, or rapid, and the wind then continued to blow from the northwestern quarter, till the close of the gale. See observations in Table II.

It may be seen that these several statements are but connected summaries of the observations which were made under different portions of the gale, during its progress.

Synopsis of the Observations.—To facilitate a satisfactory examination of this important question of rotation, I annex, in a brief and tabular form, the principal observations contained in the previous recitals; which are comprised in the three tables already referred to. The several cases are marked, in the first column, with the same numbers as before, and the order of progress is observed, except that the observations made within sixty miles of the axis line, comprising a belt of one hundred and twenty miles wide, along the center path of the storm, are comprised in Table II, while the remaining observations on the left side of the path are contained in Table I, and those from the right side in Table III. (For these tables see pp. 170—173.)

I also add the subjoined observations, obtained since the former recitals were printed.

4. Report from Capt. Brown, British ship *Gossypium*, reduced to civil time.—Sept. 30th, 1844, moderate breeze from N. N. E.; hauling northward, with hazy weather.

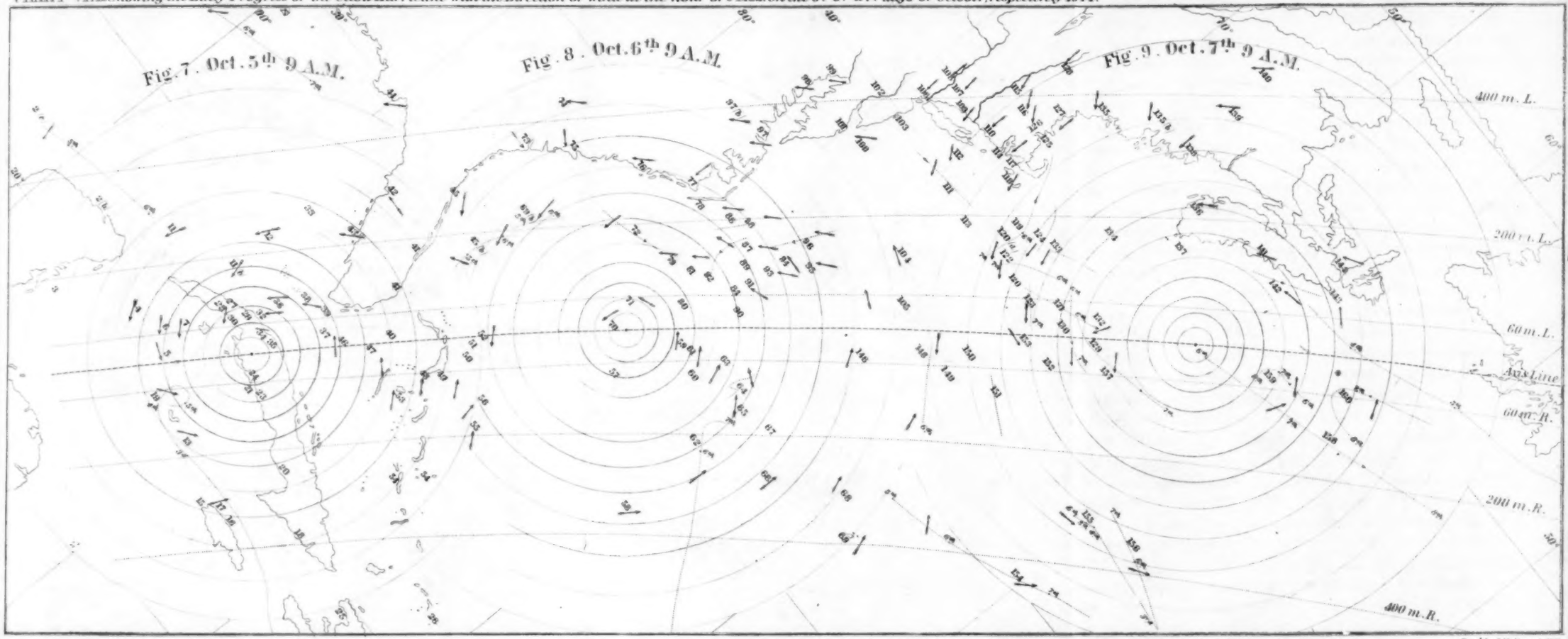
Oct. 1st, A. M., wind N. to N. N. W., gradually increasing; strong current carrying the ship to southward; lat. 20° 19′, lon. 84° 30′:—P. M., clear weather, wind N. W., increasing.

Oct. 2d, A. M., gale gradually freshening to double reefs; current one and a half knots to southward; lat. 20° 5′, lon. 85° 7′:—P. M., freshening from N. N. W., ship heading N. N. E.; (on larboard tack,) bar. 29·20; reduced sail to close reefed topsails, sent down top gallant yards; at midnight, in lat. 20° 46′, lon. 84° 37′, the gale increased rapidly to a hurricane, blowing from N. W.

Oct. 3d, A. M., hurricane with small rain and heavy sea, lying to on larboard tack with tarpaulins in mizen rigging, to keep the ship's head to the sea; wind veering from N. W. to W. and S. W.; barometer about 29 inches:—P. M., severe hurricane with rain; wind veering from S. W. to S. and S. E., from which last point it blew hardest and longest; at 11 P. M., the mainmast blew over the side.

Oct. 4th, A. M., severe hurricane; at 7 A. M., the foremast blew over the side; wind veering round from S. E. to E. and N. E.; barometer much as before:—P. M., hurricane with heavy rain; sea running very high; wind veering from N. E. to N., and inclining to moderate.

CHART VI.—*Showing the Daily Progress of the Cuba Hurricane with the Direction of Wind at the hour of 9 A.M. on the 5th 6th & 7th days of October, respectively 1844.*



The numbers show the places or vessels named in the recitals.

Engd by P.M. Atwood, N.Y.

Oct. 5th, A. M., gale continues; barometer slowly rising; wind veering from N. to N. W.; sea running high and ship laboring heavily:—P. M., strong gales from N. W. with a heavy cross sea.

Oct. 6th, A. M., winds moderate, from N. W.; lat. 20° 52′, lon. 84° 21′.

[Capt. B. gives this as an abstract of a statement drawn up at the time. It shows the same phases of the gale on the 4th and 5th as with the *Angola* (6) and *Openango* (7); while the previous report of the wind's veering "round the compass," during the gale, is also proved to be strictly correct. This statement shows, also, a perfect continuity in the double gale, at this locality, and possibly may indicate a detour in the axis-path of the second storm while in the Honduras sea, corresponding to the general system of progression which is seen on Chart I. The complete revolution of the storm-wind with this ship, whose change of position was not very great, but whose track and winds differ much in direction from those of the *Norman* (19), is quite remarkable.—Capt. BROWN says, "the ship's *drift* was about two knots an hour, forming a kind of circle." The diameter of this circuit may have been 30 to 40 miles. Capt. B. was in the Barbadoes hurricane on the 10th of August, 1831, and thinks this storm quite as bad, while it was of much longer duration. He thinks the ship must have foundered had she been on the other tack.]

11*b*. Barque *Zaida*, Sept. 27th, was near Cape Cruz, S. side of Cuba, in lat. 20° 12′, winds E. by N. to N. E., and continued to vary between N. E. and N. W. till night of Sept. 30th, ending with fresh gales from N.—Oct. 1st, at 5 A. M., made Cape Antonio, [S. W. end of Cuba,] bearing N. N. W.; wind N. N. E., fresh breezes and clear; noon, lat. 22°, lon. 85° 30′; P. M. fresh gales N. N. E., hazy. 7 P. M. took in top gallant sails.—Oct. 2d, strong breezes N. by E. and pleasant; 6 A. M. N. E. by N.; 11 A. M. single reefed topsails; lat. obs. 22° 30′, lon. 85° 28′; P. M. commences strong from N. E., squally; 3 P. M. took in jib and spanker; 4 P. M. close reefed fore and main topsails and furled mainsail, reefed foresail; ends strong gales from N. N. E.—Oct. 3d, took in fore topsail; 4 A. M. furled foresail; sent down top gallant yards and hove to; gale still N. N. E., with a heavy cross sea from N. E. and N. N. W., ship laboring hard; up N. W., off N. N. W.; noon, lat. obs. 23° 28′, lon. 84° 14′; P. M. heavy gale from N. N. E. and cloudy; midnight, heavy squalls with rain.—Oct. 4th, 3 A. M. set reefed foresail; 4 A. M. gale N. E. by N., set close reefed fore topsail and mizen topsail; noon, lat. D. R. 23° 28′, lon. 83° 40′ [?]; P. M. gale N. E. by N., squally; 5 P. M. handed topsails and courses; 8 P. M. set fore courses.—Oct. 5th, 4 A. M. wind N. by W.; 7 A. M. N. N. W., squally, a heavy sea from N. E.; noon, lat. 23° 15′; P. M. fresh gales from N. N. W., cloudy, a heavy sea from S. E., N. E. and N. W.; 2 P. M. set fore topsail and mainsail; 4 P. M. wind N. N. W.; 8 P. M. N. W. by N.—Oct. 6th, A. M. wind N. W. by N., fresh breezes and fine weather; noon, lat. 23° 27′; P. M. winds N. N. W.; 8 P. M. N. N. E. [trades] light and variable.

Capt. CHAPMAN states that during the gale the Gulf Stream current, off Cuba, had become changed in its course, drifting the *Zaida* rapidly to the westward; so that on the morning of the 7th he found himself off Cape Cartouche, in lon. 86° 40′. On the 11th of October, at 3 P. M. he picked up the two survivors of the *Saratoga*, off Cape Florida, in lat. 25° 40′. [This position of the piece of wreck appears to show, also, the extraordinary check of the surface current of the Florida stream; for these men were drifted off the Bank as early as the 7th. See case 43, *ante*. The *Zaida* evidently had the double gale; the second superseding the first, early on the night of Oct. 3d.]

Capt. MCGUIRE, of the *Rebecca* (20), states that the second gale, at Santa Cruz, began in the S. E. quarter, and went round by the S. to the westward, ending on the 5th. At 10 A. M. of 4th, had got to be very heavy, and fluctuated in tremendous squalls between S. S. W. and W. S. W. till 4 P. M., when it began to veer more westward, gradually abating.

35*b*. Capt. LESLIE, from St. Juan de Los Remedios, [N. side of Cuba, lat. 22° 37′, lon. 79° 40′,] reports that a very severe gale of wind occurred at that place on the 1st of October and continued until the 3d, commencing from N. to N. E., and ending at S. E., causing considerable damage to planters. *Charleston Patriot.*

45*c*. Barque *California*, Sept. 30th, lat. obs. 24° 51′, lon. 79° 34′; 2 P. M. fresh gales N. E. by E., cloudy, rough sea; 4 P. M. two reefed the topsails; 10 P. M. wind E. N. E.—

TABLE I.—*Left side of the Storm Path; Hurricane of Oct. 4th to 7th*, 1844.

These observations show the progressive occurrence of the storm-wind, first from the eastern and northeastern quarter, and successively changing or veering, more or less gradually, by the north, to the northwestern quarter, as the gale advanced in its course;—with the lowest state of the barometer noticed during the gale.

No.	Place, or Vessel.	Lat.	Lon.	Date and duration of gale.	Successive directions of storm-wind	Dist. from axis line.	When axis passed.	Bar. min.	Authorities and observers.	Remarks.
2.	*Maria L. Hill*,	19°51′	90°33′	Oct. 3d, to 5th,	'Norther,' ending at N.	380 miles.	3d—4th,		Logbook.	
4.	*Gossypium*, .	20 30	80 40	2d to 5th,	(4th,5th) E, NE, N, NW.	105 "	4th,	29 in.	Capt. BROWN'S statement.	Severe hurricane; dismasted.
6.	*Angola*, . .	20 45	83 40	6 A. M. 4th to 5th,	ENE, to NNE, to NW.	69 "	4th, 9 P. M.	29 in.	Log: Capt. BELL.	Severe hur.; dismasted.
7.	*Openango*, .	21 15	83 30	morn. of 4th to 5th,	E, to NNE, to NNW, NW.	74 "	9·30 "		Capt. VOSE'S statement.	Hurricane very severe.
11.	*Franklin*, .	22 40?	85 40?	4th to 5th,	N. easterly, northerly.	235 "	night,		Marine reports.	Driven 100 miles to s. w.
11*b*	*Zaida*, . . .	23 28	84	2d . 4th to 5th	NE b N, to N b W, NNW, NW b N.	180 "	"	**	Log: Capt. CHAPMAN,	Heavy gale.
12.	*H. Plantagenet*,	24 30?	83 40?	4th to 5th,	. NNE, . .	230 "	5th, 11 A. M.		Marine reports.	Gale strong from N. N. E.
29.	San Antonio,	22 55′	82 43′	5 P. M. 4th to 5th,	E, ENE, N, . .	93 "	7 " ?		Diario de la Habana.	Furious hurricane.
30.	Batabano, .	22 43	82 32	P. M. 4th to 5th,	NE, to NW.	76 "	3 "		do.	do.
31.	Guatao, . .	near	Hav.	noon 4th to P. M. 5th,	ENE, NE, NNE, . NW.	80 "	9·30 "		do.	Furious and destructive hur.
32.	Havana, . .	23 09	82 19	A. M. 4th to eve. 5th,	ESE, ENE, NE by E, N, NW.	85 "	10 "		Capt. FOSTER'S journal.	Terrific hurricane.
36.	*Tasso*, . .	23 45?	82 20?	4th to eve. 5th,	ENE, NE, NNE, N, NNW, NW.	90 "	11 "		Capt. HOWES' statement.	Hurricane.
38.	Key West, .	24 27	81 50′	A. M. 4th to noon 6th,	E, ENE, NE, N, NNW, W, NW.	118 "	2 P. M.	29·13	Rep. to Sur. Gen. LAWSON.	Destructive hurricane.
42.	Tampa Bay,	27 57	82 35	morn. 5th to P. M. 6th,	E, . NE, . .	300 "	night,	29·79	do.	W. coast of Florida.
45*a*	St. Augustine,	29 40	81 35	morn. 5th to noon 6th,	NE, N, NE, . . NW.	305 "	6th, 2 A. M.	29·82–	do.	Height of gale in night.
45*b*	*Demarara*, .	29 35	79 30	eve. 4th to eve. 6th,	ENE, NE b E, NNE, N, NNW, NW.	187 "	3 "		Log.	In Gulf Stream, off Florida.
45*c*	*California*, .	31 +	79 –	10 A.M. 5th to 10 P.M. 6th,	ENE, NE by E, N by E, NNW.	210 "	5·30 "		Log: Capt. MAYHEW.	do. off Darien, Ga.
72.	*Sterling*, . .	33 4	75 40	noon 5th to night of 6th,	NE, . N, NNW, NW.	230 to 150	9·30 "		Log.	do.; as also many others.
75.	Charleston, .	32 46	79 46	P. M. 5th to night of 6th,	E, . NNE, . NW, W.	335 "	7·30 "	29·80	Rep. to Surgeon Gen.	
76.	Cape Fear, .	33 54	78 1	night of 5th to night of 6th,	E, NE, NE, . . W.	300 "	10 "		do.	
77.	Beaufort, .	34 41	76 50	do. 5th to night of 6th,	. N, N, . .	270 "	noon,		do.	
81.	*Emeline*, . .	33 30	74 30?	5th to night of 6th,	NE, NNE, N, NNW.	117 "	do.	28·15†	Capt. SAWYER'S statement.	Severe hurricane.
82.	*Republic*, . .	33 40	74	through 6th,	ENE, NE, NNE, N, NNW, NW.	148 "	0·30 P.M.		Log: Capt. GATES.	Gale very severe.
85.	*Wm. Nelson*,	35	74	" 6th,	NE, to NW.	162 "	2 "		Marine Reports.	Severe gale.
86.	*Tioga*, . .	35 10	75	early 6th to morn. 7th,	NE, NNE, N, NNW, NW.	205 "	2 "		Log: Capt. HALLOCK.	Gale exceedingly heavy.
87.	*Cotton Plant*,	35	74	. 6th .	NE, NNE, N, NNW, NW.	162 "	2·30 "		Log: Capt. PRATT.	Ship dismasted.
88.	*B. F. Lamar*,	35 30	74 30′	early 6th to early 7th,	NE, NE b N, veering by N, .	200 "	2·45 "		Log: Capt. SANNERMAN.	Tremendous hurricane.
89.	*Clara*, . . .	34 40	73 30	. 6th .	. NNE, N, . .	120 "	2·30 "		Log.	Dismasted.
91.	*Rienzi*, . .	34 30	73 15	. 6th .	NE, E ? NNE, N, NNW, NW.	100 "	2·30 "		Mar. Rep.; Capt. CLARK.	Tremendous gale.
97.	Fort Monroe,	37	76 19	night of 5th to night of 6th,	ENE, NE, . . NW.	345 "	3 "	29 82	Rep. to Sur. Gen.	

95.	*Montpelier*, .	35°50′	72°15′	4 A.M. 6th to morn. 7th,	NE, E? NNE, . NNW.	108	"	5	"		Log: Captain's statement.	Hove down; lost topmasts,&c.
96.	*J. R. Gardner*,	36var.	73 20?	night of 5th to 6th,	NNE, NE, . N, NW.	140	"	5	"		Capt.'s PEDERSON & GOOD	Severe hurricane.
100.	*Orozimbo*, .	38 45	74 25	early 6th to noon 7th,	NE, NE, N, NNW.	320	"	7·30	"		Log: Capt. SERGEANT.	Heavy gale.
103.	*Orleans*, . .	39 30	73 30	6th to 7th,	NE, NNE, N, NNW.	350	"	8·30	"		Mates' statement.	Close reefed gale.
106.	New York, .	40 42	74 1	noon 6th to P. M. 7th,	NE, NNE, . N b W, NNW.	400	"	9·30	"	29·84–	Jour. of W. C. REDFIELD.	
111.	*Hottinguer*, .	39 40–	70to73	P. M. 6th to 7th,	NE, NNE, N, NNW.	265	"	10·30	"		Log.	Strong gale.
109.	New Haven,	41 18	72 57	noon 6th to P. M. 7th,	N b E, NE, . N b W, . NW.	359	"	11	"	29·72	Jour. of Col. CUTLER.	
112.	*Isabella*, . .	40 30	72	P. M. 6th to 7th,	NE, NNE, N, NNW, NW.	306	"	11	"		Marine Reports.	Very hard gale.
110.	New London,	41 20	72 8	P. M. 6th to P. M. 7th,	NE, . N, . W.	336	"	11·40	"		Rep. to Surgeon Gen.	Heavy rain and high wind.
114.	Newport, .	41 28	71 23	P. M. 6th to P. M. 7th,	NE, . N, . NW.	324	"	12	"	29·79	do.	
118.	Nantucket, .	41 15	70 6	P. M. 6th to P. M. 7th,	E, NE, . N, NNW.	260	"	7th, 0·30 A.M.		29·50–	Jour. of WM. MITCHELL.	Gale extremely heavy.
120.	(*a*) *Unicorn*, .	39 47	68 56	P. M. 6th to eve. 7th,	ENE, NE, N, NNW, NW.	152	"	0·30	"		Log.	Severe hur.; lost sails, &c.
124.	*Nath. Hooper*,	40 20	68 20	P. M. 6th to eve. 7th,	NE, . N, NNW, NW.	152	"	1	"	28.60†	Log: Capt. CHURCHILL.	do.
121.	*Sarah & Arsilia*,	40	66var.	1 P. M. 6th to end of 7th,	ESE, ENE, NE, NNE, N, NW.	103 to 50		3·30	"		Log: Mates' statement.	do.
123.	*Courier*,‡ . .	39 30	67var.	2 P. M. 6th to eve. 7th,	ENE, NE, NNE, N, NW.	80 to 40		2	"		Log.	do.
122.	*Zurich*, . .	40–	67var.	P. M. 6th to P. M. 7th,	E, NE, N, NNW, NW.	140 to 115		1·30	"		Log.	Heavy gale.
126.	Watertown Ars.	41 21	71 12	P. M. 6th to P. M. 7th,	NE, NE, NW.	352	"	1·30	"	29·79§	Rep. to Sur. Gen.	
127.	Portsmouth, .	43 03	70 43	P. M. 6th to eve. 7th,	E, NE, . N, .	364	"	2·30	"		do.	
128.	Hanover, . .	43 41	72 22	P. M. 6th to night of 7th,	N, N, N.	460	"	2·30	"		Jour. of Prof. YOUNG.	
133.	*Roscius*, . .	41 10	65 50	P. M. 6th to 7th,	ENE, . N, NNW, NW.	85+	"	1·30	"	28·25*	Capt. COLLIN'S statement.	
134.	*Rochester*, .	42	67	eve. 6th to 7th,	. NE, . . .	182	"	4·30	"		Marine Reports.	Severe gale.
135.	Portland, . .	43 30	70 21	eve. 6th to 7th,	SE? . N, NW, N.	368	"	4·30	"	29·73	Rep. to Sur. Gen.	
136.	Yarmouth, .	43 51	66 5	eve. 6th to night of 7th,	NE, . N, NW.	225	"	10	"		Marine Reports.	Heavy gale.
137.	*St. Petersburg*,	43 5	65 14	6th to 7th,	E, ...	152	"	9·45	"		Marine Reports.	Severe gale; lost topmasts,&c.
138.	Eastport, . .	44 53	67	end of 6th to night of 7th,	. NE, N, NW.	310	"	10	"		Rep. to Sur. Gen.	
139.	Holton, . .	46 5	67 40	" 6th to " 7th,	. NE, NW, .	390	"	10·30	"		do.	
140.	Fort Kent, .	47	68 20	" 6th to " 7th,	. NE, N, N.	460	"	11·15	"		do.	
141.	Halifax, . .	44 36	63 28	2 A.M. 7th to A.M. 8th,	NE, ENE, NE'terly, N, . NW.	168	"	11·30	"	29·23	Log H.M. ship *Illustrious*.	Ad. Sir C. ADAM, thro' Col. REID
142.	*Scylla*, . .	44 21	63	end of 6th to noon 8th,	E, ENE, NE, NNE, NNW, NW.	88 to 132		11·30	"	28·90	Log H.M. ship *Scylla*.	do.
143.	Cape Canso, .	45 20	60 58	early 7th to 8th,	SE, . to N. and NW.	98	"	2·45 P.M.			Master of Schr. *Actress*.	
144.	*Pique*, . .	45 33	61 18	early 7th to 10 A.M. 8th,	SE b E, E b N, NNE, N, NNW, NW.	130	"	3	"	29·19	Log H.M. ship *Pique*.	do.

Ships 121 and 123 were in the Gulf Stream, bound eastward; longitude uncertain. Ships 111, 122, 133, 144, with probably 137, were running rapidly westward, as was the case in some degree with several others.

† In the cases of the barometrical entries having this mark, † the several barometers have been compared with my own at New York and the corrections for index errors are here made. This remark applies to all the tables. ** Barometer said to have varied an inch.

‡ The course and drift of the Courier (123) should be more eastward than is represented in the storm charts.

§ Barometer as observed at Boston, by R. T. PAINE, Esq. * Barometer corrected by verbal information.

TABLE II.—*Center Path of the Hurricane of Oct. 4th to 7th*, 1844.

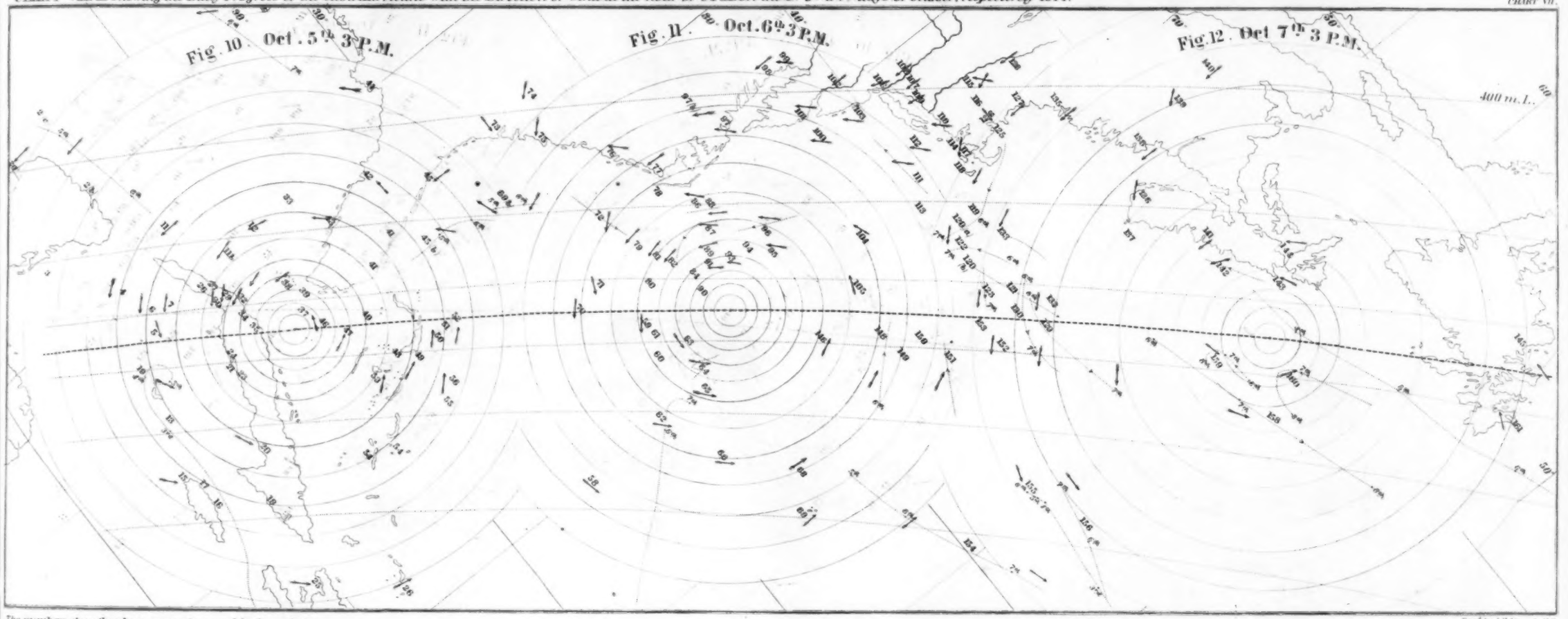
These consecutive observations show the progressive storm-wind, first from the southeastern quarter of the horizon, which, on the passing of the gale's axis, changed rapidly or suddenly to the western or northwestern quarter;—with the lowest state of the barometer observed.

No.	Place, or Vessel.	Lat. N.	Lon.	Date and duration of gale.	Successive directions of storm-wind.	Dist. from axis line.	When axis passed.	Bar. min.	Authorities and observers.	Remarks.
5.	*Majestic*, . .	20°30′	83°10′	Oct. 4th and 5th,	ESE, remission, NW, WNW.	30 miles L.	4th, 3 P. M. ?		Honduras Observer.	Totally dismasted.
34.	Matanzas, . .	23 3	81 41	10 P. M. 4th to P. M. 5th,	E, NE, variable, W.	48 " L.	5th, 11 A. M.	28 in.	Diario de la Habana.	Violent hurricane.
35.	Cardenas, . .	23 2	81 15	eve. of 4th to eve. 5th,	E, . . .	27 " L.	11 "		do.	Vio. hur. fr. 11·30 PM. 4th; 24 hs.
37.	*Columbo*, . .	24 15	80 30	11 P. M. 4th to 2 A. M. 6th,	SE, ESE, lull, sud. to WNW, § NW.	30 " ? L.	4·30 P.M.		Mar. Rep.: Mates' stat.	Hur. 30 hs., shifted sud. to N.W.
50.	*Reform*, . .	27 15	77	P. M. 5th to 11 A. M. 6th,	SE, sud. lull, SW, W. .	L. near axis.	6th, 2 A. M.		Log: Mates' statement.	Hr. S.E, sud. lull, shift to west'd.
51.	*Star Republic*,	27 25	77 10	P. M. 5th to A. M. 6th,	ESE, sud. lull, W. .	L. do.	2·30 "	28·24†	Log: Capt. HENDLEY.	Hr. E.S.E, lull 30 m. then fu. fr. W.
52.	*Josephine*, .	27 40?	77 6 ?	P. M. 5th to A. M. 6th,	SE, sud. lull, NW.	near do.	3 "		Mar. Rep. A. THOMSON.	Hove on b'm ends; lost spars.
70.	*Leonora*, . .	32 40	74 15	P. M. 5th to A. M. 6th,	ESE, veered sud. to N, NNW, NW.	L. near do.	9 "		Log: Capt. COLLINS.	Totally dismasted.
71.	*Arkansaw*, .	31 30	75	P. M. 5th to P. M. 6th,	ESE, lull, sud. to WNW.	55 m. L.	9·30 "		Log: Capt. BUNKER.	Dismasted. Furious hur.
59.	*Charlotte*, . .	32	73	night of 5th to end of 6th,	SE, NW. .	15 " R.	11·30 "		Marine reports.	Lost all but lower masts.
61.	*Victoria*, . .	32	72 30	" 6th "	SE, rapidly S, to westward.	38 " R.	noon,		Stat. fr. Capt. BUNCE.	Dismasted. Furious hur.
63.	*Potomac*, . .	32 30	71 30	" 6th "	E, ESE, .	60 " R.	1·30 P.M.		Marine reports.	Dismasted; close of g. not rep.
146.	*J. N. Cooper*,	35 50	69 7	4 A. M. 6th "	SE by E, SSE, SSW, SW, NW.	25 " ? R.	7·15 "		Capt. VARNEY's stat.	Furious hurricane.
105.	*St. Pierre*, .	37var.	69 36	1 P. M. 6th, to 7th,	ESE, SE, NW.	56 " L.	8·30 "		Marine reports.	Dismasted.
148.	*Wakulla*, . .	36 40	67 30	4 P. M. 6th, gale 14 hours,	SSE, S, sud. to NW.	148 to 20 R.	10 " ?	27·75†	Log: Capt. MULFORD.	Hove on b'm ends; lost spars.
151.	*Elvira*, . .	38 10	66 30	A. M. 6th to noon 7th,	. S, SSW, .	150 to 20 R.	7th, 0·30 A.M.		Marine reports.	Tremendous hurricane.
152.	*Nye*, . . .	38 58	65	P. M. 6th to 7th,	SE, .	47+ R.	2·30 "		Master's protest. ‡	From WM. MITCHELL; both
153.	*Mt. Vernon*, .	39	66	P. M. 6th to 7th,	SE, sud. by S, and SW to W.	6+ R.	2 " ?		Master's protest. §	ships disabled & returned to pt.
129.	*Mediator*,* .	40 25	64 20	P. M. 6th to 7th,	NE, ESE, SE, SSW, W, NW.	40 L. to 98 R.	4 " ?	28·28†	Log: Capt. CHADWICK.	Crossed axis line during gale.
130.	*St. Nicholas*,*	40 15	65 10	2 P. M. 6th to P. M. 7th,	ENE, E, SE, lull, sud. to NW.	25 L. to 31 R.	3·20 "	28·37†	Log: Capt. PELL.	do.
131.	*Cambridge*,* .	40 30	64 30	5 P. M. 6th to A. M. 7th,	ENE, ESE, SSE—SSW, WSW, W.	40 L. to 90 R.	3·45 "		Log: Capt. BARSTOW.	do.
132.	*Mentor*, . .	40 30	65	2 P. M. 6th to eve. 7th,	SE, .	24 m. L.	4·30 "		Marine reports.	Dismasted and abandoned.
157.	*Hellespont*, .	40	63 30	eve. of 6th to 7th,	hur. SSE, veering SW, .	57 " R.	5 "	28·50‡	Bermuda Gazette.	Dismasted in the hurricane.
159.	*Memphis*, . .	43 6	60	eve. of 6th, to P. M. 7th,	ESE, SE, SW, WNW.	75 to 34 R.	0.40 P.M.		Log: Capt. COFFIN.	Violent gale.
160.	*Europe*, . .	44 19	58	early 7th to morn. 8th,	SSE, S, SE, WSW to WNW.	60 to 45 R.	3·30 "	low,	Log: Capt. FURBER.	Heavy gale.
145.	*Normal*, . .	48 45	53 45	7th to 8th,	ESE, [E. true] to N. and NW. .	40 m. L.	8th, 8 A. M. ?		From a seaman of N. F.	Damaged sails.

* These three ships were in the Gulf Stream bound eastward, and crossed the line pursued by the axis during the height of the gale; the *Mediator* and *Cambridge* apparently in front of the axis, and the *St. Nicholas* nearly intersecting it. Vessels 148 and 151 were running into the gale. The winds for 146 seem better suited to a lower latitude or longitude.

§ Erroneously printed N. N. W. in the recitals. † Index error of barometer corrected. ‡ Sympiesometer.

CHART VII. — *Showing the Daily Progress of the Cuba Hurricane with the Direction of Wind at the hour of 3 P.M. on the 5th 6th & 7th days of October, respectively 1844.*



The numbers show the places or vessels named in the recitals.

Engd by J.M.Atwood. N.Y.

TABLE III.—*Right side of the Storm Path; Hurricane of Oct. 4th to 7th*, 1844.

These consecutive observations show the progressive appearance of the storm-wind, first from the southeastern quarter, and its successive changes or veering, by the south, to the western quarter;—with the lowest state of barometer noticed during the gale.

No.	Place, or Vessel.	Lat. N.	Lon.	Date and duration of gale.	Successive directions of storm-wind.	Dist. from axis line.	When axis passed.	Bar. min.	Authorities and observers.	Remarks.
13.	*Trojan*, . .	19°5′	80°50′	noon 4th to A. M. 5th,	SE, SSE, S, SSW, SW.	145 miles.	4th, 8 P. M.		Log: Capt. DAVIS.	Heavy gale.
15.	*Eastern Star*,	18 15	78 25	night of 3d to eve. 5th,	SSE, veering by S, to SW. .	315 "	10 " ?		Log: Captain's statement.	Near west end of Jamaica.
17.	Montego Bay,	18 28	77 57	4th to 5th,	. S, . . .	330 "	—		Nautical Magazine.	Destructive swell.
19.	*Norman*, . .	19	82var.	night of 3d to night of 5th,	SSE, S, SW, WSW.	200 to 100	4 " ?	28·50†	Log.	Severe hurricane.
20.	*Rebecca*, . .	20 44	78	4th to 5th,	SSE, S, SSW, WSW, W.	225 "	5th, 3 A. M.		Log: Mates' statement.	Severe gale.
25.	Bay of Gonaives	19 38	73	4th to 5th,	. S, or SW. 'erly, .	550 "	2 P.M.?		Marine reports.	Vessels driven on shore.
53.	Nassau, . .	25 4	77 18	5th to 6th,	SE, SSE, S, SSW, SW, .	90 "	9·30 "		Bermuda Gazette.	
55.	*Berlin*, . .	26	75	P. M. 5th to 6th,	SE, veering round to SW, .	175 "	6th, 2 A. M.		Marine reports.	Hurricane.
56.	*Lagrange*, .	26 30	75 30	" 5th to 6th,	SE, SSE, S, . .	127 "	2·30 "		do.	do.
57.	*Herald*, . .	30	73 30	eve. 5th to 6th,	SE, ...	75 "	8·30 "		do.	Heavy gale; dismasted.
58.	*Sea Lion*, . .	28	70 ?	night of 5th to 6th,	SE, veering round to W.	330 ? "	8·45 "		do.	do. lost sails, &c.
62.	*Pioneer*, . .	30 30	69 52	morn. 6th to midnight.	S, SSW, SW, WSW.	275 to 213	1 P.M.?	29·45	Log: from navy depart.	Through Lt. M. F. MAURY.
65.	*Brothers*, . .	32	70 22	through 6th,	SE, . S, SW to WNW.	140 "	1·45 "		Logbook.	Severe hur.; dismasted.
64.	*St. Cloud*, .	32 30	70 25	end of 5th to night 6th,	ENE, SE, S b E, SSW, SW b W.	95 "	2 "	28·40	St. from Capt. EMERSON.	Hurricane.
66.	*H. W. Tyler*,	31 30	68	. 6th, .	. S, . . .	265 "	3 "		Mar. rep.: Capt. CLARK.	Severe gale; lost sails, &c.
68.	*Falcon*, . .	32 50	65 40	6th to early 7th,	SSE, veering to S, SW, and W.	300 "	7 "		Ber. Gaz.: Capt. PITT.	Lying to eight hours.
69.	Bermuda, . .	32 15	64 40	6th to " 7th,	SSE, S, SW, .	375 "	7 "	29·86	Serg. IRWIN'S rep., sig. sta.	
149.	*St. Lawrence*,	36 50	67 2	6th to " 7th,	. . . . .	60 "	10·15 "		Marine reports.	Hurricane; dismasted.
154.	*Lowell*, . .	35	60var.	A. M. 6th to noon 7th,	SE, S, SSW, W, WNW.	380 to 460	7th, 1 A. M.		Log: Mate's statement.	Gale.
155.	*Wm. Engs*, .	37 10	60 29	8 P. M. 6th to night of 7th,	SW, veering to WNW.	316 "	3.30 "		Log: Capt. COE'S stat.	Heavy gale.
156.	*Charleston*, .	37 50	60	5 P. M. 6th to end of 7th,	SW, SW by S, WSW, W, NW.	380 to 301	6 "	28·10?	Log: Capt. CATERMOLE.	do.
158.	*Sheridan*, .	43	57var.	night of 6th to noon 8th,	E, . WSW, SW, W, WNW.	75 to 270	3·30 P.M.		Log: Capt. DE PEYSTER.	Strong gale.
164.	*Prince Albert*,	45 20	48	P. M. 7th to 8th,	E, SSE, W by S, W by N, WNW.	325 "	8th, early,		Log: Capt. SEBOR.	do.
161.	St. Johns, .	47 33	52 25	A. M. 7th to 8th,	E. 'erly, W by S, W by N, WNW.	85? "	8th, A. M.?	29·44–	Log: J. TEMPLEMAN.	
162.	*Independence*,	47 26	45 37	night of 7th to 9th,	E. 'erly, . . NW, WNW.	282 "	noon ?		Log: Capt. NYE'S jour.	Strong gale.
163.	*Adirondack*, .	46	43 20	early 8th to 9th,	NE, E, . . NW b W, var., WNW.	415 "	" ?		Logbook,	do.

No. 19 was running fast to westward, into the gale; Nos. 154 and 158 were running rapidly eastward, the latter in the Gulf Stream.

† Corrected for index error of the barometer.

Oct. 1st, gale continues; 1 P. M. took in foresail; 5 A. M. close reefed topsails and set foresail: lat. obs. 26° 6′, lon. 79° 35′, in Florida channel: P. M. heavy gale and squally with some rain.—Oct. 2d, A. M. moderate; lat. 27° 2′, lon. 79° 45′; P. M. heavy squalls of rain and rough sea; 4 P. M. furled mainsail.—Oct. 3d, gale abated, and good weather through the 4th.—Oct. 5th, 6 A. M. N. E., fresh; 10 A. M. E. N. E., freshening, cloudy: lat. D. R. 30° 49′, lon. 79° 16′: 2 P. M. E. N. E., cloudy, took in top gallant sails; 6 P. M. N. E. by E., single reefed; 8 P. M. took in mainsail, jib and spanker; 10 P. M. N. E., gale increasing, close reefed.—Oct. 6th, 2 A. M. E. by N., severe gale, hove to; 4 A. M. up E. N. E, off E. S. E.: [showing the wind at about N. N. E.: at 6 A. M. was about 220 miles from axis line of the gale]: 10 A. M. up N. E. by N., off E. N. E., [wind N. by W.?] heavy gale; noon, lat. obs. 31° 13′, lon. 78° 51′; 2 P. M. N. N. W., more moderate, set foresail; 4 P. M. out one reef from topsails and courses; at 10 A. M. gale had ceased, and light winds came from the eastward.

The logs of the *Demarara* and *California*, with the other accounts, will enable us to trace the first gale more perfectly, in its progress from Cuba.

65. Brig *Brothers*, for New York, Oct. 5th, winds N. W. to S. W., set top gallant sails; noon, lat. 30° 48′, wind W. N. W., light, cloudy; 6 P. M. calm and much rain; 8 P. M. light breeze from N. E.; midnight, moderate breeze from S. E.

Oct. 6th, begins wind S. E., and at 8 A. M. had increased to a strong gale, close reefed the topsails and furled the courses and fore topsail; at 10 A. M. hove to, blowing very heavy, in lat. 32°, lon. 70° 22′; at 11 A. M. blowing a hurricane from S. E., cut away the main topmast and also the deck load, the brig nearly on her beam ends; noon, still increasing; all hands at the pumps, blowing a complete hurricane, which at 2 P. M. had shifted to S. W., making a tremendous sea and heaving the brig on her beam ends; cut away the foremast; at 4 P. M. gale abating and a tremendous sea; at 8 P. M. wind had veered to W. N. W.—Oct. 7th, light winds from W. N. W. to N. W. and a heavy sea; noon, lat. 32° 19′. [Logbook.]

97*b*. Dr. JOHN AUGUSTINE SMITH, who was at a point in Virginia about 60 miles W. N. W. from Fort Monroe, informs me that on the 6th October the storm exhibited there the character of an ordinary northeaster.

144. H. M. S. *Pique*, river St. Lawrence, first Cuba gale:—Oct. 3d, A. M. winds southeasterly, strength 2 to 4, weather b c, c; 9 A. M. bar. 30·24 in.; noon, 30·20; lat. 49° 30′, [lon. 66° 26′,] St. Ann's River S. by W. ½ W. 22 miles. P. M. winds southeasterly, light; 8 P. M. bar. 30·19.—Oct. 4th, begins calm; 4 A. M. S. E. 4, c; 8 A. M. 5, m g; 9 A. M. bar. 30·18; 10 A. M. wind S. S. E., 4 b c; noon, S. S. E., 5; bar. 30·17; lat. 49° 41′, [lon. 64° 42′, off the W. end of Anticosti.] At 1 P. M. wind S. E., 6; reefed topsails and spanker, down royal yards; 2 P. M. split jib and set fore staysail, bar. 30·12; 3 P. M. 7 b c q; 4 P. M. two reefs in topsails; 6 P. M. wind S. E., 5, c; 8 P. M. 4, c, bar. 30·08, set top gallant sails; 10 P. M. S. E. by E., 5, c.—Oct. 5th, 1 A. M. S. E. by E., 5, c; 2 A. M. 6, c q; in third reef of main topsail; 4 A. M. 7, c q r; set reefed foresail, close reefed and furled fore and mizen topsails, down top gallant yards and housed the masts; 5 A. M. wind E. S. E., 7; 6 A. M. 8; 8 A. M. S. E., 7, c r q, bar. 29·44; 9 A. M. E. S. E., 6, o q d; 10 A. M. 5, bar. 29·36; 11 A. M. S. E. by S., 5; noon, S. E. by E., 4, o q r, bar. 29·31; lat. 49° 35′, [lon. 64° 35′,] off W. end of Anticosti:—1 P. M. wind S. E., 2; up top gallant masts and yards and made sail; 2 P. M. bar. 29·28; 3 P. M. wind S. by E., 3; 4 P. M. 3 bar. 29.23; 6 P. M. S. S. W. 4, c q, *bar.* 29·16; in second reef of topsails and driver; 7 P. M. set top gallant sails; 8 P. M. wind N. W. b N., 2, o c, bar. 29·19; 11 P. M. wind W. S. W., 3, c r; midnight N. W., 4, b m. [This shows the axial center of the first gale to have passed near the *Pique*, with indications of an extensive central lull or remission. For the continuation of this log see recital 144, as previously given.*]

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* This further extract has been obtained through the favor of Col. Reid.

THE PARADOX OF REVOLVING WINDS.—It is still possible that some persons may not be able to understand, clearly, how the wind in a progressive storm which revolves in one constant direction around its axis, can at the same time be found to veer in opposite directions, on the opposite sides of the axis line, as is seen in Tables I. and III. respectively. But this fact, of which an explanation has already been attempted, may be seen to be a necessary result of the law of rotation, as manifested in all revolving bodies; and failing to understand this law, no one can intelligently pursue the inquiry.

Let a circular disk of stiff paper be written upon in one or more circular lines, around its center, either in a concentric or vorticose form; then put this disk in rotation upon its center, and pass two fingers across it in parallel directions, one on each side of the axis, and it will be found that one finger passes the circular writing in the order in which the words are written, while on the opposite side of the axis the other finger, though moving in the same direction, will pass over the writing in the opposite or *reverse* order to that in which the words are written. Of course this will equally follow in case the revolving disk be advanced under the fingers, as when the fingers are advanced over the disk.

The two opposite orders of succession in which the letters are thus presented on the revolving disk, are equivalent to those of the winds which are presented to separate observers on the two opposite sides of the storm. This then being the law of rotation, it follows, that if the general course pursued by a storm be known, two rough observations of the order of changes in the wind, one on each side of its axis path, may be quite sufficient to determine its revolving character; provided that the early and later winds near the axis path have blown transversely to the course of progression; to determine which, even the same observations may suffice.

PROOF OF ROTATION AFFORDED BY DIRECT INSPECTION.—Perhaps it may be deemed that the rotation of great storms, as a question of fact, resting on observations, was as distinctly determined in the case of the American storm of Sept. 3d, 1821, or that of August 16th, 1830, as by the great case which is now before us.* But the latter affords data of a more precise and

* The jointly revolving and progressive movement of the entire storm which visited Connecticut on the 3d day of September, 1821, was distinctly ascertained in

extended character than is often obtained, and is, therefore, well suited to remove doubts from those who are unaccustomed to a course of specific inquiries. To such, the proofs of rotation afforded by a direct inspection of simultaneous observations, when plotted on a map, may be more satisfactory. This case is also a favorable one for the study of navigators; who must necessarily become acquainted with the progressive character and determinate changes of revolving gales, or submit to the inevitable evils of neglecting such knowledge.

For these objects, it proves favorable that the unusually rapid progress of this hurricane was such as to enable us to show, on the same chart, a separate development of the daily advance of the storm, and the simultaneous direction of its wind on all sides at the same hour, on successive days. This is first done on Chart IV, where the place of the storm at noon of each day, as approximately determined, is denoted by separate sets of concentric

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the course of that month. This unexpected result, as made apparent also in other storms, was made known without reserve to the writer's friends and others, but was not published in any Journal till April of 1831, when the westerly progression in low latitudes was also distinctly shown. It was not till seven years later (1838) that I became acquainted with the suggestions and opinions of Col. CAPPER, and with the particular views and elucidations published by Prof. DOVE in his paper on Barometric Minima, found in POGGENDORF's Annalen, 1828.

To the valuable investigations of Prof. DOVE, I am anxious to do full justice. But I have found some degree of difficulty in ascertaining the *extent* in which his elucidations and views of certain storm-winds, as exhibited in his article above mentioned, coincided with the main results of my separate inquiries; a difficulty which perhaps may be owing chiefly to my want of acquaintance with the German language and with the modes of illustration used at that time by this distinguished inquirer.

It is evident that the integral rotation of the trade and general winds in performing their great circuits, both in the northern and southern hemispheres, is in the direction which is opposite and reverse to that which is uniformly found in the revolving storms or eddies which are carried forward in these general currents of rotation. Thus the great rotative and geographical course of the latter, in the northern hemisphere, is successively from S., W., N., E., S.; while the rotation of a storm, borne along by this current, proceeds successively from S., E., N., W., S.; being the opposite direction of rotation. At the same time, the constant *tendency* of the difference of velocity in the earth's rotation, in different latitudes, is to favor or produce, locally, such *leftwise* movements of rotation as the storms exhibit in the northern hemisphere; at least in those parts of the general currents which have a progression towards the polar latitudes, and as apart from the concurrent influences of rotation which may exist in greater or less force in various regions. This leftwise tendency of rotation in storms, may be counteracted in the opposite parts of the great circuit, in returning towards the equator.

lines; and the direction of wind at that hour, so far as determined by direct or approximate observation, is indicated by the several wind-arrows.

To avoid any chances of error, the like delineations are also made for different periods of the day, at intervals of three hours each; which will be found on Charts V to X, inclusive. These are drawn on the same scale and ground work as Chart IV, and are severally derived in like manner from the observations. This will afford opportunity for mariners and others to contemplate the progressive changes which are produced, on different sides, by the advance of the revolving storm.

This manner of plotting the simultaneous observations, for inspection, was adopted in my notice of the New England storm of Dec. 15th, 1839; but without the advantages of a successive exhibition at daily intervals, which the present case affords.*

If any inquirer, who is careful to apprehend rightly the several accounts relating to the wind's direction, and the true periods of the several successive changes there mentioned, shall conclude that any of the wind-arrows found on these Charts are without sufficient authority, he has only to cancel the same and rely on those others which he may deem to be more truly determinate; and it will easily be seen whether the proof of a general rotation of the storm-wind is at all invalidated by such omissions.

Vortical Inclination of the Storm-Wind.—By this is meant some degree of involution from a true circular course.† In the New England storm above referred to, this convergence of the surface winds appeared equal to an average of about six degrees from a circle. In the present case, such inclination seems more or less apparent in the arrows on the storm figures of the several charts; where the concentrical circles afford us means for a just comparison of the general course of wind which is approximately shown by the several observations. In some *quadrants* of the storm, as thus exhibited, the average inward convergence, at certain periods, may amount to two or more points of the compass. This may possibly be due in part, to the trending of the coast, and also more probably to the very prevalent habit of re-

* This Journal, vol. xlii, p. 117. Trans. Am. Phil. Soc., vol. viii, part i, p. 81.
† *Ante*, vol. i, Second Series, p. 14.

ferring nearly all northeasterly and northwesterly winds to the northeast and northwest points specifically.

Perhaps we may estimate the average of the vorticose convergence, as observed in the entire storm for three successive days, at from five to ten degrees,—out of the *ninety* degrees which would be requisite for a congeries of centripetal or center-blowing winds. This rough estimate of the degree of involution is founded only on a bird's eye view of the plotted observations. But however estimated, this involution seems to afford a measure of the air and vapor which finds its way to a higher elevation by means of the vortical movement in the body of the storm. It probably finds its limit at various and unequal distances from the general center of revolution, and at a very moderate elevation from the earth's surface; according to the existing conditions and activity of the storm. That it does not commonly extend over the entire area of central inactivity, which is found at the earth's surface, may be inferred from the general absence of rain, and sometimes even of clouds, in this axial area of the storm.

Observed Direction of the Storm-Scuds.—It may be of some importance to notice, that, so far as can be settled by my own observations of the storms of the United States, the directions of the *scuds* which fly in the most active portion of the gale, intermediately between the earth's surface and the great stratus cloud which overlies the gale, and below any regular cloud stratum, *have generally no inward inclination* in their course, as regards the gale's axis; but rather the contrary. By careful observations, these scuds are commonly found to fly from directions which are from half a point to one or two points *more to the right*, on the compass card, than the direction of the storm-wind at the earth's surface. The elevation of these floating scuds is also comparatively small; and in the rainy portions of the gale, appears chiefly comprised in a range from five hundred to twenty-five hundred feet above the surface.

These results are nearly alike common, whether the observer be placed on the axis path of the storm, or on the right or left side of this path; and are found in a large portion of the true storm-winds, from the north round by the east to the southwest. If there are some apparent exceptions, arising from irregularities in the attending or overlying winds, or from invisibility of scuds

and the presentation of other cloud-currents, it is believed they will not invalidate the general results of the observations.*

In the case before us, I can find no strict observations directed to this point, except my own; which, on the afternoon of the 6th, show the wind from N. N. E. and the storm-scud from N. E., being the not unusual difference.

ACCELERATED ROTATION IN THE BODY OF THE STORM.—We find in this case, as in other storms, a greatly accelerated velocity of rotation in the wind as we proceed from the exterior limits towards the axis of the gale, till we reach that interior portion where the destructive force of a hurricane was exhibited. This is in accordance with the universal law of vortical revolution, which seems no other than the law of *equal areas in equal times.* Like the vortical involution, this acceleration finds its principal limit externally to the region of central inactivity in a storm; and, in some storms and localities, at a very great distance from the geographical center of revolution; the active portion of the

* From the observations found in my journal I select only the following. The several columns show, successively, the dates,—observed direction of the storm-wind at the surface,—the simultaneous direction of the storm-scuds,—and lastly, the mean range of the barometer in the storm, reckoned from its next previous and subsequent maximum.

Dates.	Winds.	Scuds.	Range, inches.
1832, Nov. 19,	SSW.	SW.	0·80
" 22,	NNE.	NNE. brisk,	0·53
" 23,	WSW.	W.	"
Dec. 15,	NE.	ENE.	0·29
1833, Jan. 13,	NE. by E.	ENE.	0·86
" "	NNE.	NE.	"
Feb. 7,	NW. by N.	NNW.	0·22
" 13,	ENE.	E.	0·70
" 19,	SSW.	WSW.	0·57
Oct. 12,	ESE.	SE.	0·90
1835, March 22,	NNE.	NE.	1·02
May 15,	N.	NNE.	0·29
1836, Jan. 10,	N.	NNE.	1·01
April 22,	NW.	NNW.	0·59
May 3,	SSW.	WSW.	0·58
" 12,	SE.	SSE.	0·70
" 30,	NE. by E.	ENE.	
June 2,	NE. by E.	E. by N.	
" 4,	NE. by E.	ENE.	
" 21,	NE.	ENE.	0·29
July 13,	NE.	ENE.	0·25
" 22,	N. & NNE.	NE.	0·54
Oct. 4,	NE.	ENE.	0·75
Nov. 20,	ESE.	SSE.	0·56
Dec. 21,	SSE.	S.	1·00
1837, Jan. 21,	NE. by E.	NE.	1·25
Feb. 28,	NW.	NNW.	1·18
March 13,	S.	SSW.	0·70
" 22,	NE. by E.	ENE.	0·40
April 26,	NNW.	N. by W.	0·37
1837, June 2,	S.	SW.	0·78
" 7,	ENE.	E.	"
" 18,	N.	NNE.	0·52
1838, March 3,	NE.	ENE.	
June 23,	SE.	SSE.	0·29
Sept. 6,	ENE.	E. by N.	
Oct. 19,	ESE.	SE.	0·67
1839, Jan. 15,	NE. b E.	ENE.	
June 3,	ESE.	SE.	
" 4,	E. by N.	ESE.	
" 18,	S.	SW.	0·20
Aug. 30,	NNE.	NE.	0·35
Nov. 5,	E.	ESE.	0·71
Dec. 4,	NNE.	NE. b E.	0·30
" 16,	NNW.	N.	0·75
" 22,	ENE.	E.	1·01
1840, April 23,	SSW.	SW.	0·40
May 9,	NE.	ENE.	0·32
" 21,	NE.	ENE.	0·64
" 24,	ESE.	SE.	"
1841, May 30,	NE.	ENE.	
June 23,	ESE.	SE.	0·24
Aug. 29,	NE.	ENE.	
Oct. 4,	N. ¼ W.	N. by E.	0·36
Nov. 19,	NE.	ENE.	0·34
1842, Feb. 3,	SSW.	SW.	0·89
" 16,	SE. b S.	SSE.	1·43
" 26,	ENE.	E.	
May 20,	NE. b N.	ENE.	
Dec. 13,	NE. b E.	ENE.	0·61

storm having, in these cases, somewhat the form of an annular disk, of great internal diameter.

THE AXIAL REGION.—The lull or abatement of the wind's force in the center of the hurricane or gale, is a marked feature of this and other active storms. The superficial extent of this area of inactivity seems variable and uncertain. It is commonly found to be greatly extended as the storm advances into the higher latitudes; where, not unfrequently, it seems to become merged with a general remission in the force of the easterly winds which belong to the anterior portion of the gale; as may be seen in the more advanced stages of this storm, (reports 161 to 165,) and perhaps may be shown more fully hereafter.*

This axial lull and the shift of wind which immediately follows it, must be distinguished from sudden but more partial changes in the wind's direction at greater distances from the center, which may result from mere oscillatory movements in the advancing axis or from the concurrent force of adjacent winds, or other causes, and which may be communicated over large portions of the most active part of the gale. This unequable shifting or veering is strongly exemplified in the reports from the *Roscius* (133) and *Wakulla* (148), concurrently on different sides of the axis, at nearly the same time; as if the higher portion of the storm had measurably overrun the lower, in its progression, and suddenly taken its place at the surface. Some lesser degrees of this unequal veering, and sometimes of a fluctuating or oscillatory character, may be seen in other parts of the storm.†

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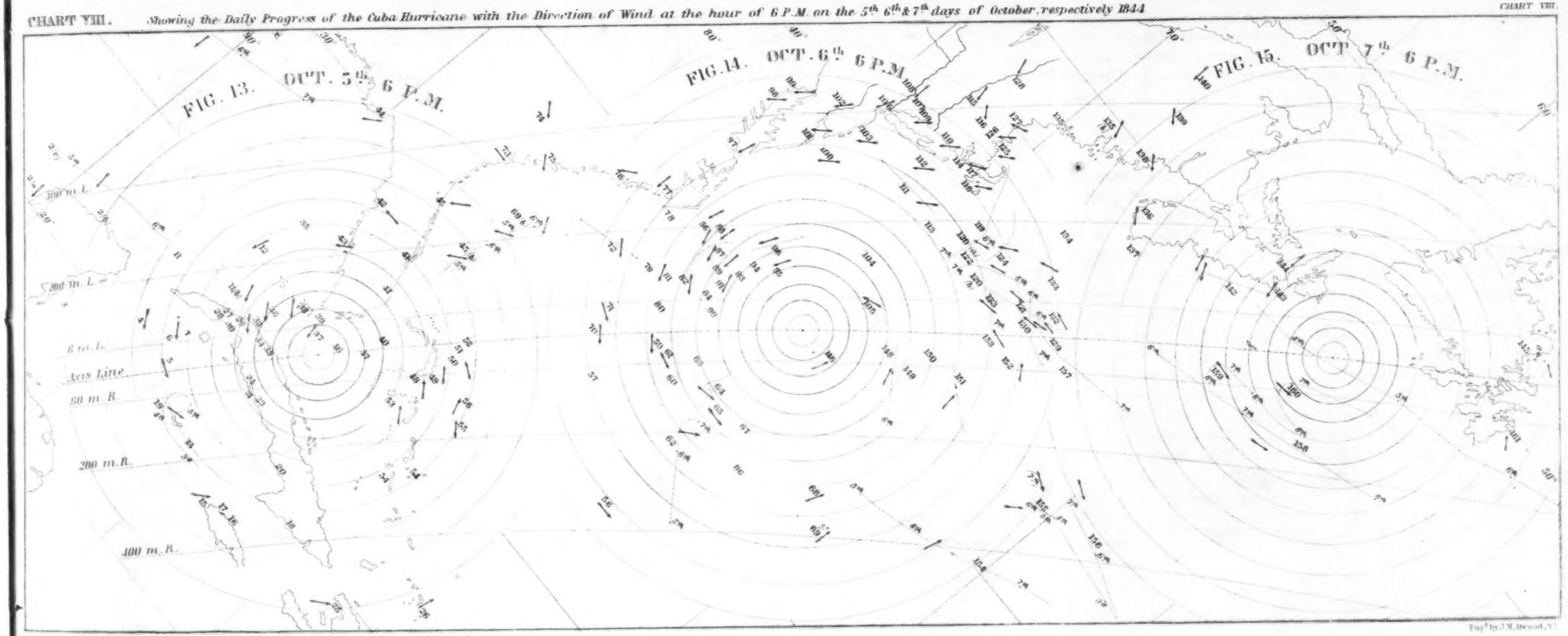
* It might be inquired how far the direct *momentum* of the violent and onward wind in the right hand side of the storm path may favor its partial or complete *oversliding* of the more sluggish atmosphere on the earth's surface, in passing to the front of the storm, in the higher latitudes; thus approximating more nearly to a true plane of rotation. If any possible weight can be allowed to this suggestion, which, to a limited extent, is accordant with an idea of the late Prof. LESLIE, it may perhaps serve in explaining the comparative inactivity of the easterly winds in this and other storms of the Atlantic, in the higher latitudes, particularly in the colder portions of the year, when, often the principal strength and duration of the gales are found mainly in the westerly winds of the posterior side of the storm, on a rising barometer; as is frequently experienced in navigating between Europe and the northern portions of America. But the slower easterly rotation of the earth in higher latitudes, in a constantly reducing ratio as the gale advances, appears to afford a better explanation of this somewhat common inequality of force in the anterior and posterior sides of the storm.

† Recital 160, and others.

CHART VIII. *Showing the Daily Progress of the Cuba Hurricane with the Direction of Wind at the hour of 6 P.M. on the 5th 6th & 7th days of October, respectively 1844*



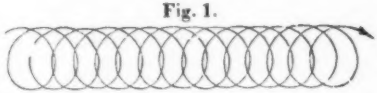
Engd by J.M. Atwood, N.Y.

The numbers show the places or vessels named in the recitals.

Oscillations of the Axis of Rotation.—We may infer that the centrifugal force, within the body of the revolving storm, will seldom be equally balanced on all sides, by the exterior pressure which is indicated by the barometer, and that the impulsion which results from the temporary predominance of pressure on any side, will be propagated around the axis, causing the latter to move in a series of spiral revolutions, or curvilinear deviations, during its progression. This revolving oscillation may often be observed, even where there is no progression of the whirling body; as in the case of a vortex in water discharging into an orifice or through a funnel. This oscillation of local pressure and the eccentrical revolution of the axis, may go far, among other causes, in explaining the *flaws*, *puffs*, *gusts*, and *squalls*, as they are loosely and sometimes interchangeably called, which are so very common in violent storms; and, in the larger movements, may account for some of the irregular changes previously noticed.

Phenomena of Axial Oscillation.—The specific course of the actual center of gyration, under the oscillations referred to, must differ greatly in storms which have different rates of progression. It has been shown by Mr. Piddington and Mr. Thom that the progression of some storms of the Asiatic seas and Indian ocean, during some portions of their advance, has been as slow as *three miles and even two and a half miles per hour*. This remarkably slow progress, in connexion with the axial oscillation, must produce unusual conditions in places near the center of the storm, and may serve to account, in part at least, for the most extraordinary series of opposite and successive shifts, veerings, and calms, recorded by Mr. Lloyd as having occurred at Port Louis, Mauritius, in March, 1836, in a slow moving hurricane which lasted three days.* In this storm, the line pursued by the axis of gyration might have been somewhat like that seen in the following figure.

Fig. 1.



In this case, if we suppose the circuit of the axial oscillation to have been equal to the diameter of the lull, inclusive of the interior edge of the gale, this course of its axial point would produce, on or near its center path, a series of oscillating changes not unlike those observed by

* London Nautical Magazine, June, 1837.

Mr. Lloyd. It is proper to add, also, that Port Louis is situated near an abrupt ridge of mountains which might have greatly disturbed the regular course of the wind at that place.

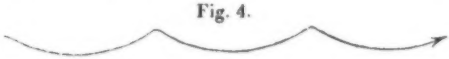
With a higher rate of progression the center of gyration might move on a line or course more like the following:

Fig. 2.

But with a very rapid progression in the body of the storm, like the case before us, the revolving center or point of gyration might describe a line more nearly like one of the two following figures.

Fig. 3.

Fig. 4.



Such oscillations of the axis of a storm, however, cannot easily be detected, for want of sufficient and exact observations in the axis path, in those regions where the winds have free action. They may be best noticed in a storm of slow progress, like that of Mauritius, above mentioned, but may also be often evinced in other observations. In the case before us, we find cause to infer that some deviations existed in the axial course, without being able to determine these with precision.

Circuit Sailing in Storms.—In the rapid progression of the Cuba hurricane, no great portion of a circuit of revolution would be described by any vessel, in sailing before the wind. Nor is the ordinary progress of the Atlantic gales sufficiently slow to induce often such a result, under the courses ordinarily steered in these gales. But I have formerly shown a case on the American coast, furnished me by Capt. T. H. Sumner, where a ship, in scudding before the gale, performed nearly half the circuit of the horizon, before the gale abated.*

In the slow progression found in storms of the eastern seas, as already noticed, not only a complete circuit of revolution, but more

* Ship *Cabot*. See Journal of Franklin Institute, June, 1839, vol. xxiii, p. 370; with a diagram.

than one circuit might sometimes be made in a gale by the same vessel, in sailing around the axis of the storm; thus adding another practical demonstration of its revolving character. One such case of complete circuit sailing I have referred to, in 1836.* Mr. THOM, in his account of the Rodriguez storm of April, 1843, has shown that the *Robin Gray* run once and a half times around the axis of the storm, from left to right, ↻, (this being in the *southern* hemisphere,) till, being thrown on her beam ends, she was prevented from continuing her circuits. In the same storm the *Argo* made part of her second circuit, scudding round in the gale in the same direction. In like manner the *Margaret* made a circuit and a quarter around the axis, chiefly in the heart of the gale. Several vessels, after once falling out of this hurricane, pursued their course, again overtook it and plunged into the heart of the storm, where they suffered most serious disasters.† It appears probable, and indeed certain, that nearly all of the great loss and damage sustained in this hurricane might well have been avoided, by a knowledge of the laws of rotation and progression in these storms.

But the most striking case of circular sailing in a storm is that of the *Charles Heddle* in a hurricane near Mauritius, in February, 1845, which has been furnished me by Mr. PIDDINGTON. This was a clipper built vessel, once a slaver, and was bound from Mauritius to Muscat. It appears from the log, that in her course, round and round in the gale, the wind veered five complete revolutions in one hundred and seventeen hours, with an average run of eleven and seven-tenth knots per hour, the whole distance thus sailed being thirteen hundred and seventy-three miles; while the progression of the hurricane, at this period, *was less than four miles an hour.* The average distance from the gale's axis is estimated at about forty-five miles. During this time, the vessel made good a course S. W. $\frac{3}{4}$ W., three hundred and fifty-four miles, only; nearly on the usual course pursued by the hurricanes, near Mauritius.‡

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* Lond. Nautical Magazine, April, 1836, p. 205. This Journal, vol xxxi, p. 122.

† Nature and Course of Storms in the Indian Ocean; with Diagrams. Lond. 1845.

‡ These highly interesting cases of circuit sailing in storms give proofs of their revolving character not unlike those which are afforded of the earth's rotundity in voyages of circumnavigation: and, like the latter, may be received by some who perhaps may not be able to appreciate the evidence, equally conclusive, from other sources.

These are results obtained by Mr. PIDDINGTON, who has already published his Twelfth Memoir, and who informs me that he is preparing another on this hurricane of the *Charles Heddle.* In his Eleventh Memoir, he has given an account of two storms, which were nearly contiguous, but on opposite sides of the equator, and revolving in counter directions, ↻ ↺, each according to the law of rotation and progression of its own polar hemisphere.*

VERTICAL HEIGHT OF THE STORM WIND.—What is the general height or thickness of the storm, and by what means can this be approximately determined? These questions and their solution are doubtless of some importance in their bearing on meteorological theories, and seem to deserve our attention.

In nearly all great storms which are accompanied with rain, there appear two distinct classes of clouds, one of which, comprising the storm-scuds in the active portion of the gale, has already been noticed. Above this, is an extended stratum of stratus cloud, which is found moving with the general or local current of the lower atmosphere which overlies the storm. It covers not only the area of rain but often extends greatly beyond this limit, over a part of the dry portion of the storm, partly in a broken or detached state. This stratus cloud is often concealed from view by the nimbus and scud clouds, in the rainy portion of the

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* Prof. DOVE, in his paper on barometric minima, alledged that storms in general are whirlwinds,—that the turning or rotation of storms in the southern hemisphere is in the opposite direction to those in the northern; and he adduced certain European storms as turning from S. W. to W. and N. W., and says that most of the hurricanes compared by him, in the southern hemisphere, are in the opposite direction, that is S. W., S. E.; but probably different in different longitudes, (Pogg. Ann. 1828, pp. 597, 598.)—Both these directions, however, are seen to be contrary to the true rotative direction in the storms thus refered to; and I am at a loss to know if he did not then consider the opposite veering of the winds, on opposite sides of the barometric minima, to be evidence of two opposite and distinct rotations.

The opposite rotation and polar progression in the storms of the two opposite hemispheres, had early appeared to me as a probable if not necessary result, and was soon confirmed by the evidence of numerous facts, of an isolated but uniformly consistent character. This point was summarily alluded to in this Journal for October, 1833, vol. xxv, pages 121 and 128. In the last named instance, the complete inversion of the storm-winds, as exhibited on the center-path of the storms in southern Australia, was referred to as conclusive evidence.

Col. REID, in his work, published in 1838, has given the results of his inquiries on the rotation and progression of the hurricanes of the South Indian ocean, which afford ample proofs of the opposite polar relations in the storms of the two hemispheres.

storm, but, by careful observations, may be sufficiently noticed to determine the general uniformity of its specific course, and, approximately, its general elevation.

The more usual course of this extended cloud stratum, in the United States, is from some point in the horizon between S. S. W. and W. S. W. Its course and velocity do not appear influenced, in any perceptible degree, by the activity or direction of the storm-wind which prevails beneath it. On the posterior or dry side of the gale, it often disappears, before the arrival of the newly condensed cumuli and cumulo-stratus which not unfrequently float in the colder winds, on this side of the gale.

It appears, therefore, that the proper storm-wind revolves entirely below the great stratus cloud which covers so large a portion of the storm; and we may infer, also, that the production of the accompanying rain and the depressing effect of the storm's rotation on the barometer, are chiefly confined within the same vertical limit. In regard to rain, this result is in accordance with observations on the quantity which falls at different elevations above the earth's surface; and in the case of the barometer, a like accordance is shown in the diminished range of the mercury in storms which is found in ascending from the ocean level.

The general height of the great stratus cloud which covers a storm, in those parts of the United States which are near the Atlantic, cannot differ greatly from one mile; and perhaps is oftener below than above this elevation. This estimate, which is founded on much observation and comparison, appears to comprise, at the least, the limit or thickness of the proper storm-wind, which constitutes the revolving gale.*

It is not supposed, however, that this disk-like stratum of revolving wind is of equal height or thickness throughout its extent,

* See this Journal, vol. xxxi, p. 127—128. If a disk be cut from the thin paper of Chart IV, of a size which will represent one thousand miles in diameter, it will be found to have a thickness which represents more than a vertical mile, by the scale of the chart. A disk of the same size, but on a scale representing a storm of but 400 miles diameter, if cut from the paper of this Journal, will also represent more than a mile of vertical thickness, in the storm. These and other analogous considerations, deserve the attention of those who may think that winds are mainly induced and supported by movements or influences of a vertical character or tendency. It might be useful for those holding such views, to attempt to draw out the supposed paths of vertical induction and geographical progression in the winds, on an accurate and uniform linear and vertical scale, for the purpose of attaining a more precise standard for estimating the supposed vertical action or influence.

nor that it always reaches near to the main canopy of stratus cloud. It is probably higher in the more central portions of the gale than near its borders, in the low latitudes than in the higher; and may thin out entirely at the extremes, except in those directions where it coincides with an ordinary current. Moreover, in large portions of its area there may be, and often is, more than one storm-wind overlying another and severally pertaining to contiguous storms. In the present case, we see from the observations of Prof. SNELL and Mr. HERRICK, at Amherst, Mass. and at Hamden, Me., (115 and 135 *b*) that the true storm-wind, at those places, was super-imposed on another wind; and various facts and observations may be adduced to show that brisk winds, of great horizontal extent, are often limited, vertically, to a very thin sheet or stratum.

LOCAL TORNADO IN THE CUBA HURRICANE.—The accounts from Matanzas mention a destructive phenomenon of this kind as having taken place at Yabu, (in the central part of Cuba, lat. 22°, lon. 29° 34′, on the right of the axis line,) during the hurricane. It is described as "a tremendous water spout which passed through the place, doing much damage," and confined to a narrow path. "The effects were the same as if a violent river had run through the town, leaving a kind of channel." This case has since been mentioned, erroneously, as having occurred in Mexico.

The appearance of violent tornado-vortices within the body of a great storm is not new nor very unfrequent. A remarkably destructive case occurred at Charleston, S. C., on the 10th of Sept., 1811, during a great storm which visited our coast. It caused the loss of a great amount of property and about twenty lives. Its track was about one hundred yards wide; and it followed the course of the local storm-wind, from southeast to northwest, transversely to the progression of the great storm. Two very violent tornadoes appeared in New Jersey, in a general storm, on the 19th of June, 1835, moving in different but nearly parallel paths, at an interval of several hours. These pursued the course of the higher general current which then overlaid the great storm.* Several other tornadoes, together with numerous gusts

* One of these was the New Brunswick tornado, described in this Journal, vol. xli, pp. 69—79. See also foot note, vol. xliii, p. 276.

and severe thunder squalls appeared on the same day, in different places, within the compass of the same general storm. Another tornado occurred on the 13th of August, 1840, at Woodbridge, near New Haven, Ct., during a general storm, following the local direction of the storm-wind, from S. S. E. to N. N. W.; transversely to the course pursued by the larger storm.

These with other cases which might be adduced, may serve to show that the small tornadoes which sometimes occur in great storms have no essential or inherent connexion with the vortex of the larger storm, even in those cases in which the courses of progression may chance to coincide.*

We have further to notice the barometrical phenomena of the two Cuba storms, their geographical relations to contiguous winds and currents of the lower atmosphere, and some of the practical bearings of the subject upon the interests of commerce and navigation.

ART. XVI.—*On Zoophytes*, No. II; by JAMES D. DANA†.

8. THE word zoophyte has been translated *an animal that grows like a plant*, and in this sense it is well applied to the several species so designated. It is a curious question, how animals can have the mode of growth of vegetation, and yet be wholly removed from the vegetable kingdom; how some species may form mossy tufts, others lichen-like fronds, others resemble shrubs and trees, and yet possess not a single one of the essential characteristics of vegetable life: how, too, these animals form structures of *coral*, a material harder than marble and like it in composition, and thus cover the ocean's bed with shrubbery and flowers of living stone. There seems to be much mystery in the subject; but the greatest wonder will be found to consist in its simplicity. It is in fact so extremely simple, that the mind in ignorant surprise overleaps the true explanations to be found close at hand,

* In like manner, common thunder storms are often known to appear in or above the local portions of a great storm. An examination of this class of storms will show that the narrow tornadoes and thunder storms often extend to a greater height than the great gales or hurricanes.

† The abstract of the Exploring Expedition Report on Zoophytes commenced in the last number, is here continued, with such modifications or additions from other sources, as would adapt the subject to the pages of this Journal.

and goes on wondering at complexities of its own creation. Life we cannot understand; but the facts which living beings present to the eye may be read with as much clearness in the animalcule, as in the animal of higher intelligence; and even more distinctly in the former, as its organization is less complex. We shall find as we proceed that the formation of coral is no more surprising than that of the oyster shell or the bone of the quadruped, as the power of secretion belongs to the most stupid lump of vitality, and is the lowest of all the attributes of living beings. We shall learn too that the mode of growth which leads to the spreading tree as its result, is a consequence of simplicity, and far less wonderful, if a comparison can be made, than the process which models the diviner form of man, though the zoophyte is usually deemed the greater mystery. Corals and coral zoophytes may become a very common-place subject to some minds, when brought out of the realms of mermaids "deep in the wave;" yet we venture to believe that the world as created by its Author needs no finishing touch from the hand of man to render it worthy of our admiration and profound study.

General Characteristics of Zoophytes.

9. Zoophyte is a general term used in the same manner as *plant* in the vegetable kingdom. There are species, as we have stated, which are single animals, and others like the Madrepore tree that are compound; some form coral, and others, not. The several individual animals in either case are called *polyps*.

A mouth, and a tubular cavity below possessing powers of digestion and assimilation, are all the essential constituents of a polyp. They thereby eat, digest, and grow; and reproduction follows as a result of the animal structure. They are usually attached at base, and at the opposite extremity have a circle of arms (tentacles) around the mouth. Thus equipped, they fulfill their destiny, without any of the senses, without a distinct nervous system, with no provision of glands, no heart or system of circulation, and no distinction of sex. Such is the polyp in its simplest form. Fixed in its site upon some rock or sea-weed, it remains with open mouth and extended arms, waiting for such chance bits as may come in its way.

10. In more precise language, it may be described as *an animal of the class Radiata, having an inarticulate fleshy body near-*

ly cylindrical; a circular or elliptical summit called the disc, bordered by one or more series of tentacles, and an opening or mouth at the centre of the disk: internally, *a visceral cavity which is closed below; no distinct vascular system; an imperfect nervous system or none; no senses but that of touch; no distinction of sex.* The mouth is a simple opening through the fleshy disc, without organs of manducation, and it is the only exit from the visceral or internal cavity. The body, and in most instances, the tentacles also, are expanded by means of water received from without, mostly through the mouth, and which is ejected on contraction. Instead of having gills,* the whole surface of the animal, inside and out, takes part in the function of aëration, through the air of the exterior and interior waters.

The polyp in its simplest form (see figures 2 and 3, page 197) is essentially then merely a fleshy bag, or tube of flesh, closed at one end; and within the walls of this tube nearly all the processes of life are carried on. There is no division of labor—no separate organs for different functions, as in the higher animals; nutrition, aëration, and reproduction, belong equally, as far as can be discerned, to all parts of the simple structure. With animals of this kind it would seem to be of little importance which side of the bag was innermost; and it is a fact with the Hydras that they may be turned inside out, and still eat, digest, and perform all the functions of life as before.

11. Only the lower grade of polyps have the extreme simplicity above described. As a *first* step in advancement, the upper part of the visceral cavity becomes partially separated from that below and serves as a stomach. The *second* step is more important; it consists in a localization of the function of reproduction, in addition to the farther perfection of the stomach. The stomach, a simple tube, occupies the centre of the visceral cavity, being attached to the disc immediately below the mouth. The space in the visceral cavity outside of the stomach and below it, is divided into vertical compartments by a radiate series of fleshy lamellæ or plates, part of which bear seminal cords on the margin, and part, clusters of ova.

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* Organs somewhat resembling gills are found in the family Zoanthidæ; but none have been detected in other polyps.

These higher polyps, though similar in many respects, are thus distinct from others in having a set of organs growing from the walls of the visceral cavity devoted to the function of germination instead of this function residing in the walls themselves; and they illustrate the first step in the system of localization,—the distributing of different processes in the animal economy to distinct organs—by which the higher animals differ from the lower. The ova in the one case grow outward from the sides of the polyp, escaping laterally by simple pullulation: in the other, they form at the margin of the ovarian lamellæ, *within* the visceral cavity, and escape by passing up through the stomach and mouth.

12. It is perceived that the mysterious polyp is a very simple kind of organism, and we thus far detect no evidence of a vegetable nature. We observe that while the plant extends its roots and absorbs nutriment from the soil or atmosphere, the polyp obtains its nutrition, like other animals, from food in a stomach; in the process of digestion, assimilation, defecation, as well as the action of the circulating fluid on air, they are *in toto*, animal.

13. Yet we are struck with the points of external resemblance —the flower-shaped disk—the circle of tentacles corresponding to the petals of the flower—and the series of germinal lamellæ or dissepiments in the higher grades, situated within, like the stamens, and pistils or carpels of the flower.

This resemblance is rendered more striking by the mode of *budding*, on which the compound structure of zoophytes depends, as it is singularly like the production of buds in a plant. As seen externally, the bud in many instances appears first as a slight swelling on the side of a polyp: it enlarges, and after a while a new polyp gradually grows out, with tentacles and visceral cavity complete: it usually remains thus united to the parent for life, though sometimes becoming detached and swimming off free. Comparing it with the growing plant-bud, we find no essential difference in the process, though in one case the result is an animal, and in the other a flower or branch of leaves. The new polyp at first communicates internally with the parent by its visceral cavity as well as the tissues of its sides, and often this intimate connection continues after becoming adult.

This process, as is obvious, may go on without limit; the parent may give out other buds, and all may add to the number

by continued budding: and why then should not the polyp form a tree, at least as well as the budding plant? This is in fact the true explanation of the formation of a zoophyte. An accumulation of polyps goes on by this succession of developments, and the same forms result as in vegetation—the tree, the shrub, the lichen, cactus column, or sphere. The laws governing this process will be considered on a future page. We repeat here a former remark that this budding may and does take place independently of coral secretions, as the secretion of coral is not an essential character of polyps, though belonging to many of them.

14. The compound zoophyte is hence a result of the budding process. The young polyp, after a short life of freedom, (a few days or less,) finds a place of attachment and then begins to bud, and by this means of multiplication, the stem rises, and branches are formed. The zoophyte is therefore a cluster of polyps, having generally an intimate connection with one another. The animals have each a stomach, with tentacles and a mouth for conveying food to it: but there is a free intercommunication of the fluids through the uniting tissues, by side pores or lacunes, and in some cases, even by the visceral cavities. It is precisely like a thousand digestive sacs and mouths contributing to the nutriment of a single layer of animal tissue.

15. A still more singular mode of reproduction, often the subject of remark, presents another striking analogy between the plant and the zoophyte:—the process of reproduction from *artificial sections*. It is well known that we may as easily raise a polyp from cuttings as a tree. Trembley and Baker* long since proved fully the title of the Hydra to the name it bears; for the knife was unsparingly used, and only resulted in multiplying Hydras. They were cut into halves, and soon each was a perfect Hydra. One was divided into three parts, and in three or four days in summer, the tail had produced a head, the head a tail, and the middle part a head at one end and a tail at the other; and even before completion, they sometimes began to give out buds. From forty parts as many Hydras resulted. The body slit

* Abraham Trembley, on Freshwater Polyps, (Memoires pour servir à l'histoire d'un genre de Polypes d'eau douce,) 1 vol. 4to., *Leyden*, 1744; and Phil. Trans., vol. viii, of the Abridgment, 1742.—Henry Baker, A Natural History of the Polype, 8vo. *London*, 1743.

open reunited, even if previously laid out flat, like a membrane, and new tentacles in a short time replaced those that were cut off. Two polyps may be made to change heads, for one may be grafted on the body of another. Every portion of the animal excepting perhaps the tentacles, which failed in the hands of Trembley and Baker, is thus capable of forming a perfect Hydra. "What is still more extraordinary, polyps produced in this manner grow much larger and are far more prolific in the way of their natural increase, than those that were never cut. It is very common when a polyp is divided transversely, to see a young one push out from one or other of the parts, and sometimes from both of them, in a very few hours after the operation has been performed; and particularly from the tail part, two or three are frequently protruded in different places and at different times, long before that part acquires a new head, and consequently while it can take in no fresh nourishment to supply them with; and yet the young ones proceeding from it, under these disadvantages, thrive as fast, and seem as vigorous as those produced by perfect and uncut polyps."*

16. Another fact equally strange is presented by these animals. Sir John Graham Dalyell, whose investigations in this depart-

* Baker, pp. 92, 93.—We cite the following closing remark on this subject from the highly classical work of G. Johnston, M. D., on British Zoophytes, (History of British Zoophytes, Edinburgh, 1838; p. 107.)

"When such things were first announced—when to a little worm the attributes of angelic beings were assigned,† it is not wonderful that the vulgar disbelieved, albeit credulity may be their besetting sin, when even naturalists, familiar with all the miracles of the insect world, were amazed and wist not what to do. 'Il faut,' exclaimed Reaumur, 'il faut porter la foi humaine plus loin qu'il n'est permis à des hommes éclairés, pour le croire sur le premier témoignage de celui qui le raconte, et assure l'avoir vu. Peut-on se résoudre à croire qu'il y ait dans la nature des animaux qu'on multiplie en les hachant, pour ainsi dire, par morceaux?'‡ But this illustrious naturalist was himself the first to promulgate, and experimentally to verify, the discoveries of Abraham Trembley, which have been fully confirmed by many subsequent inquirers, and are now made so familiar to us by their admission into elementary works and treatises on natural theology, that we read of them with little surprise and without incredulousness."

† Vital in every part, not as frail man
In entrails, heart or head, liver or veins,
Cannot but by annihilating die;
Nor in their liquid texture mortal wound
Receive, no more than can the fluid air,
All heart they live, all head, all eye, all ear,
————————and, as they please,
They limb themselves, and color, shape or size
Assume, as likes them best."—MILTON.

‡ Hist. des Insectes, vi, Pref. 49.

ment of science are among the most remarkable that have been made, has observed that a species of Actinia on the coast of Scotland, instead of waiting to be cut up into bits in order to raise a progeny, actually separates fragments for the purpose from its base, by the ordinary process of growth. "Small irregular fragments of no determinate shape detaching themselves from the base, gradually become perfect Actiniæ; in the course of a year, seventy were thus detached from its basal margin, which consequently became ragged and disfigured. The external organs were gradually developed, and in three weeks the young Actiniæ were perfected from the rudest and most misshapen fragments."* We are at once reminded of the bulbs that grow from certain plants, and drop off to sprout up, bud and flower. Instead of proving the vegetable character of the polyp, these facts only establish the identity of certain laws of life in both kingdoms.

17. Reproduction in polyps, we thus perceive, takes place both by means of ova and buds; that is, these animals are both *oviparous* and *gemmiparous.*

I. *Ova.* The ova either (1) form in the sides of the animal, and grow from the outer surface;—or (2) they form from internal lamellæ, and escape through the mouth.—In some instances, as distinguished by M. van Beneden, (3) an ovum appearing at first to be single, undergoes a subdivision in its yolk, and becomes a number of distict ovules, each producing separate young. The ova in (1), are sometimes spoken of as *bulbs.*

The ova sometimes produce the young before they leave the polyp, and the animals are then in fact *viviparous.* But as the external waters have free admission to the interior, this may be considered but an accident in the oviparous mode.

II. *Buds.* Buds (1) develop young which are *persistent*, that is, remain attached to the parent:—in other cases (2) they develop young which separate when mature, or are *caducous:* sometimes (3) the buds proceed at intervals from an elongating shoot called a *stolon:* again, (4) they sometimes separate as *bulbs* before the young are developed: again, (5) these separating bulbs, before development, may contain ova.† This last process is analogous

* Cited from a recent letter to the writer.

† This last fact was first distinguished by M. van Beneden.—See his elaborate memoirs on the Tubularidæ in the Transactions of the Royal Society of Brussels; also, Ann. Mag. Nat. Hist., xv, 346.

to the occurrence of eggs in the larves or imperfect young of insects.

Artificial sections may be considered another means of reproduction. The process however depends on the same cause as that of budding—the absence of a concentrating nervous system: it matters little whether the fragment remains as a part of the parent, or be detached from it.

18. The facts which have been presented, indicate a natural subdivision of Zoophytes into two groups or orders, as follows:

I. Hydroidea. Visceral cavity, a simple tube; reproductive functions residing in the general walls of the cavity; young or ova pullulating from the sides of the parent.

II. Actinoidea. Visceral cavity divided vertically by fleshy lamellæ; reproductive functions belonging to the margin of the fleshy lamellæ; young or ova set free in the visceral cavity, and escaping from it by passing up through the stomach, out of the mouth.

The Hydroidea are small species, sometimes forming corneous, but never calcareous coralla, and contributing nothing essentially to reefs. The name is derived from Hydra, one of the included genera. The order Actinoidea comprises all the ordinary reef-forming Zoophytes, together with the Actiniæ and allied species. The name is from Actinia, which comes from the Greek ακτιν, *a ray of the sun*, and alludes to the radiate flower-like summit.*

* The characters given exclude the Bryozoa, a group embracing the Flustras and Cellepores. Their relations to zoophytes are briefly explained in the last volume of this Journal, page 287. They have an intestine, which curves back and terminates in an anus near the mouth, and in this and other respects differ from true zoophytes, as we have used this term.

Zoophytes pass into the class Acalephæ through the Actinecta on the part of the former, and the Porpitæ and the Velellæ on the part of the latter, which are all floating oceanic species, and have nearly similar tentacles about a central mouth. Passing beyond these species, the structure of the Acalephæ varies widely from the Actinoidea; the internal cavity, the germinal system, tentacles, and general habit, becoming very different. The Hydræ closely resemble the young of certain Acalephs, and have been lately classed with the Acalephæ, especially on account of the structure of their tentacles, which are furnished with minute dart-bearing or filiferous sacs. (See Dujardin, Ann. des Sci. Nat., iv., 1845, p. 258.)

The *Sponges* are also excluded; if animal, they have little in common with zoophytes excepting their plant-like forms and the most general properties of animal life, as no distinct animals allied in any way to polyps have ever been detected. Of recent authors, Grant, Audouin, Milne Edwards, Bowerbank, Dujardin, and Laurent, consider sponges as animal; while Link, Blumenbach, Owen, Hogg and G. Johnston, are inclined to place them in the vegetable kingdom.

Order Hydroidea.

The Hydroidea are minute polyps of extreme simplicity of structure and delicacy of form. Though sometimes single animals swimming at large or attaching themselves at will, like the Hy-

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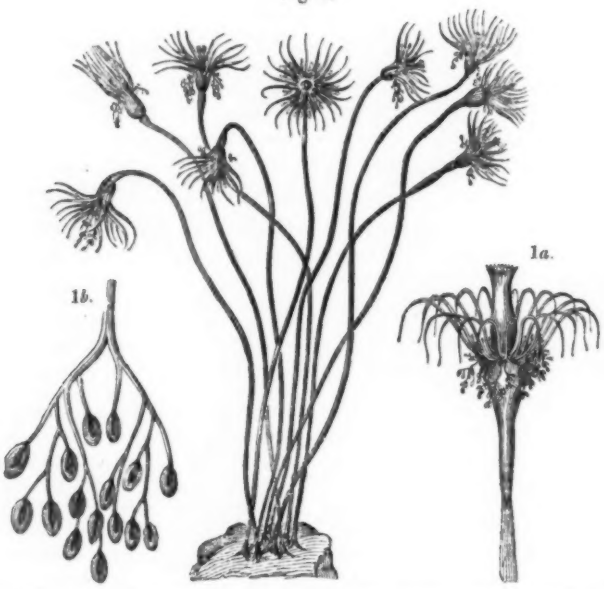
See Grant, Edinb. Phil. Jour., xiii, xiv; Dujardin, Ann. des Sci. Nat., x, 5, 2d series, 1838, in which he endeavors to show, by minute microscopic research, that they are compound infusoria; Laurent, on the Spongillæ, L'Institut, 1840, pp. 223, 231, 240, and the Microscop. Jour., i, 78, who describes the reproductive organs of the supposed animals; Hogg, on the Spongilla, Linn. Trans., xviii, 390, who sums up the results of his investigations in the following language:—"They have no tentacles, no cilia, no mouth, no œsophagus, no stomach or gastric sac, no gizzard, no alimentary canal, no intestine, no anus, no ovaria, no ova, no muscles or muscular fibres, no nerves or ganglia, no irritability or powers of contraction and dilatation, no palpitation, and no sensation whatever. Surely, then, we cannot any longer esteem these natural substances to be individual animals, or even groups of animals, in which not one organ, nor a single function or property peculiar to an animal, can be detected." The existence of ova is placed beyond doubt by the investigations of Laurent; and these ova have animalcule-like motions when first produced. This fact has been considered decisive; but as the spores of some Algæ have similar life-like motions, this evidence alone is not satisfactory. The analyses of Sponges by Croockewit have proved, according to Mülder, (Chem. Veg. and Anim. Phys., Amer. ed., p. 303,) that the fibres have the same composition as the *fibroïn* of silk—that is, the part of silk left after dissolving out the gelatine and albumen. The sponge differs only in having the fibroïn combined with sulphur, iodine and phosphorus. It consists of carbon 48·01, hydrogen 6·35, nitrogen 16·06, oxygen 26·40, iodine 1·05, sulphur 0·46, phosphorus 1·67. (Scheikundige Onderzoekingen, Deel ii, p. 1.) This fact certainly adds weight to the side of the animal nature of sponges.

Judging from all the recent investigations, it may be received as most probable, that *sponges are the result of animal growth;* that the minute component animals are more analogous to infusorial animalcules than polyps; that they receive nutriment by absorption at the surface without distinct stomach cavities opening outward through a mouth; and owing to this simplicity of structure, the individuality of the animalcules is nearly or quite lost in the general structure, just as the individuality of cellules in a simple growing animal is merged in the resulting organism; that they are therefore in effect simple individuals, though they may be viewed as analytically compound. A perfect analogy is afforded by vegetation: for while in most plants growth takes place through the formation of successive buds, (plant-individuals,) all at first as distinct nearly as the polyps of a zoophyte, in others, (like some Algæ,) there is a progressive elongation or enlargement of a growing stem or frond, without any appearance of constituent parts or buds in any period of the development; and reproduction proceeds from the surface of the general structure, as in sponges.

The limits of the two kingdoms of nature, the vegetable and the animal, are still in obscurity. It would seem as if the two lines diverged from the same low organisms; for besides the moving spores of Algæ, there are actual animalcules which are claimed by the Botanist, on the ground that they act on the atmosphere like plants, giving out oxygen instead of carbonic acid. The argument appears to be good, notwithstanding the living motions they present, and their complete re-

dra, (figs. 2 and 3,) they usually form compound groups, hundreds and often thousands to a cluster. Some, as in the annexed figure* (fig. 1,) grow in crowded tufts or thread-like stems; ma-

Fig. 1.



semblance to other infusoria. The effect mentioned depends on the nature of the process of nutrition, which is of more importance than the motion of vibratile cilia. The principles of growth depend on vitality; but the animal functions consist more or less completely in the chemical processes of composition and decomposition constantly going on in the organism. Now, it appears to be a law which pervades all existences, organic and inorganic, that action must have its alternate season of rest; there is vibration in molecular forces,† as well as alternate action and rest in the operations of life. Consequently the successive changes attending nutrition and growth, going on in a monad, may give alternate or seriate action to the cilia or other means of motion; and if sufficiently minute, and free to move, the organism will have progressive motion, whether plant or animal. No nervous system is necessary. In higher animals a nervous system is given to accumulate and concentrate power; in a higher plant, there is no nervous system, and little concentration, and the organism remains fixed without motion. Owing to the constitution of the plant, the action on air results in giving out oxygen, and it appropriates inorganic substances as nutriment: and for a like reason the animal gives out carbonic acid on respiration, and it subsists mostly on organic food.

* These figures are by J. P. Couthouy, and represent a species from Rio de Janeiro, which he designates *Tubularia ornata*. Fig. 1 shows the animal of natural size. These and the other illustrations, excepting figs. 2, 3 and 5, are copied from the Exploring Expedition Report on Zoophytes by the author.

† See Faraday's views on molecules, Phil. Mag., May, p. 345, 1846.

ny are much branched, and each branch is tipped with a star of tentacles, as in the following figures 4 and 5. In the coralla of

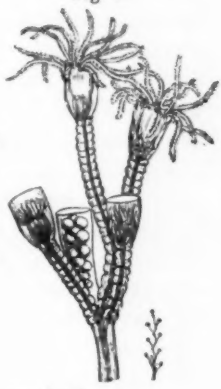
Fig. 2.

Hydra.

Fig. 3.

Fig. 4.

Fig. 5.

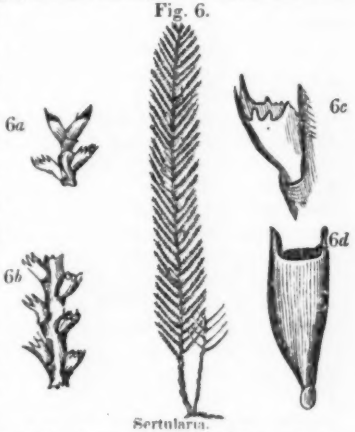


Campanularidæ.

a greater part of the species, minute calicles or little cups, but indistinctly visible to the naked eye, are arranged in one or more series along the branchlets, and the cluster is a neat imitation of the most delicate plumes (fig. 6) trailing vines or mossy tufts; and when alive, every calicle is the site of a polyp-flower. These zoophytes are occasionally but a few lines in height; yet others no less minute in their cells and polyps, attain a length of several feet.

20. The species are sometimes fleshy throughout, (figs. 2, 3,) forming no cells or corallum; though generally they have a delicate corneous or cartilaginous exterior; the minute cell or calicle is of the same nature, and is properly the exterior of that part of the animal which surrounds the stomach. The accompanying figure (6) represents one of the plumes,—a Sertularia,—with parts of a branch, (6*a*, 6*b*,) and a calicle (6*c*) enlarged. Under a microscope they are objects of exquisite beauty, especially when covered with the delicate polyp-flowers. On contraction, the arms

Fig. 6.



Sertularia.

of the little animal are here folded away (fig. 5.)* The stomach communicates with the tubular cavity below it, (figs. 4, 5,) and empties into this cavity the chyloid fluids after digestion. There is thus a community of visceral cavities often throughout a whole group, and the several polyps eat for the general good. The fluids (as the writer has observed, but which has been more fully ascertained by Lister and others) vibrate back and forth, or have a cyclosis movement like the circulation in a Chara, sometimes flowing quite into the stomach again; in connection with admitted water, they take the place of a proper circulating fluid.† There are floating particles as in the circulating fluid of other animals. Thus aëration and assimilation go on without any of the usual appurtenances of gills or glands.

The tentacles are commonly slender tubular,‡ and become expanded by injection with water. They usually aid in capturing animalcules, minute crustacea, or whatever prey comes within reach; and they apply themselves to the work with considerable dexterity, though less nimble than the more active Bryozoa. In some species they are short and sluggish, and can subserve only the purpose of aëration.

* There appears here to be a retreat into a cell; but in fact, it is only the head or upper part of the polyp, and not the polyp itself, which becomes concealed. The whole animal has a cartilaginous or corneous exterior, excepting the very summit and tentacles, and these consequently, on contracting, fall down into the extremity of the tube. This extremity is the part about the stomach, and the animal is usually larger here than below; when not larger, there is generally no retraction of the polyp's head.

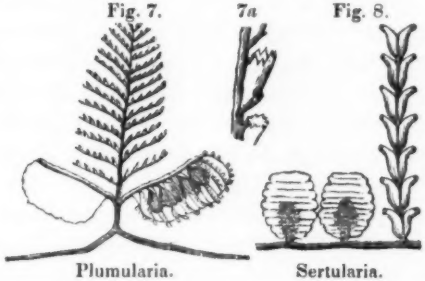
† J. J. Lister, Philosophical Transactions, 1834, p. 369, with fine illustrations on plates 9 and 10.

We quote the following from his very interesting observations. The current "flowed in one channel, alternately backwards and forwards, through the main stem and lateral branches of a plume, and through the root, as far as the opacity admitted of its being traced; sometimes it was seen to continue into the cells. The stream was throughout in one direction at one time; it might be compared to the running of sand in an hour-glass, and was sometimes so rapid in mid-tide that the particles were hardly distinguishable; but it became much slower when near the change. Sometimes it returned almost without a pause; but at other times it was quiet for a while, or the particles took a confused whirling motion for a few seconds; the current afterwards appearing to set the stronger for the suspension." "Five ebbs and five flows occupied fifteen minutes and a half; the same average time being spent in the ebb as in the flow." Lister states that the vibrating motions of the internal axial fluids were first noticed by Cavolini in his *Memorie per servire alla Storia de' Polipi Marini*, published at Naples, in 1785.

‡ The Tubularidæ and Campanularidæ, are described by van Beneden as differing from the Sertularidæ and Hydræ in not having these organs properly tubular. The tentacles of the Hydræ instead of being naked are armed with minute filiferous capsules, which ally them to the Acalephs, (see note to p. 194.)

21. Reproduction takes place by all the different modes mentioned in § 17, excepting that from internal lamellæ, which characterises the Actinoidea.

Ova.—The ova grow from the sides either singly or in clusters; and the clusters are naked as in figure 1, 1*b*, or enclosed in membranous cases or vesicles. The figures 5, 6, 6*d*, 7, and 8,



represent some of these ova-bearing vesicles. They gradually develop from the side of a branch, or at times from a creeping root-like shoot, which grows outward like the creeper of a plant, sending up its buds and flowers at intervals (fig. 8). They sometimes may be shown to be the production of particular polyps in a cluster, and in other cases individuality seems to be lost and they belong rather to the group as a whole. The ova are easily distinguished arranged along an axis, or on one side of the vesicle, and Lister has shown that they communicate through this main axis with the trunk of the zoophyte and the fluids vibrate into them. Dr. Charles Pickering, an associate in the Exploring Expedition, pointed out to me in 1838 the close analogy which subsists between the structure of a vesicle with its included ova, and a branchlet of the zoophyte. This singular point has been thoroughly investigated by E. Forbes, Esq., and the fact of this arrangement fully ascertained.* The above figure (fig. 7) is a good example of the fact; it is by Dr. Pickering and was drawn from the specimen on which the observation was made. The vesicle to the right contains evidently in its structure all the elements of the central pinnate frond, and appears as if made by folding together the branchlets from either side of the midrib, these branchlets and traces of the calicles being distinct over the surface of the vesicle.

* Rep. Brit. Assoc. for 1844, p. 94.

On coming to maturity the ova develop their young, either at the time of leaving the vesicle or soon after, and the vesicle becoming vacated, drops off. The young soon plant themselves upon some support and bud and branch, and soon become a grove of corallines. According to van Beneden the Campanularidæ when first developed are like minute Medusæ in shape, and have eight eyes, which are lost as the animal attaches itself.* Sir J. G. Dalyell, who had previously observed their forms, states that the young, after the tentacles are formed, enjoys the faculty of progression by means of the inverted tentacula, as on so many feet, apparently to select a site; when again resuming the natural direction with the extremities upward, the lower surface fixes itself below and roots there forever.†

22. *Buds.*—Buds in the Hydras fall off after coming to maturity; but occasionally they give out successive shoots till small compound groups are formed, though ultimately becoming each an independent animal. In the Sertulariæ and most other species, the buds are persistent. In some instances, before the zoophyte has reached its limits in size, the number of polyps constituting it becomes immensely large. In a single specimen of Plumularia (P. angulosa), collected by the writer in the East Indies, there are about twelve thousand polyps to each plumose branch; and, as the whole zoophyte, three feet long, bears these plumes, on an average, every half inch, on opposite sides, the whole number of polyps is not short of eight millions; all the offspring of a single germ, and produced by successive buddings. In the development of the bud, there is at first a protuberance in which the chyloid fluids gain access, and either move by vibration or have a kind of circulation up along the sides and down the axis; after a while the calicle forms, the polyp extends its arms and begins its contributions to the body-coralline. The annexed figures represent different results of the process. In figure 9 the cells are in a

Fig. 9.

Fig. 10.

Fig. 11.

* Mémoires sur les Campanularies, &c. Brussels, 1844.

† Rep. Brit. Assoc. for 1834, p. 600.

single series, each polyp budding out one, which becomes the summit one, this another and so on. In figure 10 there are two series; the axis lengthens between the two terminal and then buds again other two at the extremity, and so the branch lengthens. In figure 11 there is a series of clusters, the budding process being in part intermittent.

In some Tubularidæ, certain caducous gemmules change into delicate flat memberless animals resembling a Planaria, and which consequently were called *planules* by Sir J. G. Dalyell.* These, according to Van Beneden, are the developments of the buds alluded to on a preceding page, (§ 17,) which contain ova.

23. Connected with the process of growth and reproduction, there is a corresponding process of dying often going on in the older parts of a zoophyte: the polyps disappear, and the lower branches often drop off, leaving the trunk in this part bare. These zoophytes are thus dying and budding in different parts at the same time. In the large species, the main stem or midrib of the zoophyte becomes lifeless, or a mere support for the numerous lateral plumes or branchlets.

24. Besides this mode of limiting the existence of these polyps, some Hydroidea are said to be absorbed in their cells, and after a while to reappear again; and this has been observed to take place at nearly regular intervals. All the polyp cells of a living group have been found, after a certain period, empty, or with only the remains of the wasted polyps, the fluid of the trunk showing the only evidence of vitality by its continued vibration. And in the course of a few days other polyps have appeared in the vacated cells, with the same perfection of form and the same activity and life as their predecessors. The polyp heads, as Sir J. G. Dalyell states respecting a Tubularia, sometimes seem to drop off like a deciduous flower, and again, after ten days or more, are reproduced. Harvey observes, that after he had kept his specimens two days, they began to look unhealthy; and on the third "the heads were all thrown off, and lay on the bottom of the vessel." After another three days, changing the water in the mean time, the polyps were entirely renewed, with no essential difference, except absence of color. The cold of winter is said sometimes to strip a corallum of its polyp-flowers, which remains thus apparently dead till

* Rep. Brit. Assoc. for 1834, p. 602.

spring, when it is warmed anew to life, and the flowers once more appear.*

25. In conclusion, the Hydroidea are animals with no *external* organs but tentacles and a mouth, and no *internal*, but a simple stomach cavity and its prolongation below in the form of a tube or tubular axis. *Without any special glandular system, and with but a single opening to the alimentary cavity*,—the food is digested by the gastric fluid of the stomach, and the refuse matter ejected by the mouth. *Without a special absorbent or a circulating system or branchiæ*,—the digested material of the stomach passes downward into the tubular axis, where it has a vibratory or cyclosis movement; and here it is farther elaborated by the action of air from the admitted water, and becomes absorbed and assimilated by the surface of the cavity, or of the tubular organs, cavities, or pores, connected with it—these chyloid fluids acting in place of a proper circulating fluid; aëration of the same also takes place through the tentacles and the exterior surface of the animal, which receive air from the waters about them. *Without ovarian glands*, almost any part of the polyp possesses the reproductive function, excepting the tentacles; and buds or ovules are formed, and pass out directly from the sides of the animal. *Without a distinct nervous system*, in addition to the above negative characters, every part seems equally a centre of organic forces (unless we except the tentacles), and consequently sections made almost indefinitely, still live and complete the entire polyp again.

ART. XVII.—*Law of Electro-Magnetic Induction;* by CHAS. G. PAGE, M. D., Prof. Chem. and Pharm., Columbian College, Washington, D. C.

As the first fruits of the *Axial Galvanometer*, (see this Jour., i, ii Ser., 242,) I have to communicate the establishment of a definite law of inductive action of currents upon soft iron, and a direct practical corroboration of the law of Ampère as to the modifying influence of distance upon induction.

First: *As regards the inductive action with reference to surface and mass.*—Although the weight of authority upon this point, has regarded the action of helices, spirals, or *concentrated*

* J. G. Dalyell, Edinb. New Phil. Journ., xvii, 411; Harvey, Proceed. Zool. Soc. No. 41, p. 55; Lister, Phil. Trans. 1834, 374, 376.

action upon soft iron, as proportional to the surface independent of the mass, I had long since suspected the fallacy of the position; and this mainly from the fact, that when the magnetism of soft iron was made to react upon the helix in the development of secondary currents, the intensity of such currents always appeared to be augmented in proportion to the increase of the mass of soft iron—*that is, with the same helix.* For instance, a tube of soft iron gave much less reaction, as judged of from the spark and shock, than when a solid bar of the same diameter and length was used; and from the well known law of action and reaction, nothing else could have been *inferred* than that the *development of magnetism was in proportion to the mass and not to the surface.* The *axial galvanometer* clearly establishes this point. The apparatus used in the experiments consisted of a small Grove's battery, of six pairs—three helices, formed each of the same length of wire, but each having central openings or *bores* of different diameter—several bars and tubes of soft iron,—and a delicate spring balance. The bore of helix No. 1 was $\frac{1}{2}\frac{0}{0}$ inch diameter; helix No. 2, $\frac{1}{2}\frac{1}{0}$, and helix No. 3, $\frac{1}{2}\frac{2}{0}$. Soft-iron bar No. 1 was four inches longer than the helices, and $\frac{9}{2}\frac{9}{0}$ inch diameter, and when suspended within the helix No. 1, was distant from it $\frac{1}{2}\frac{}{0}$ inch; having therefore freedom of motion within the helix. It is not important in these experiments, that the axis of the bar should exactly coincide with the axis of the helix; for the sum of all the actions is the same for every position of the axis, as found by careful experiment. Soft-iron bar No. 2 was hollow, of the same length and diameter as bar No. 1, and half its weight. It is important that the lengths should correspond, for reasons to be hereafter given. Soft-iron bar No. 3 was of the same diameter as bars 1 and 2, but shorter by two inches.

When bar No. 1 was suspended to the hook of the spring balance, and inserted about half way through helix 1, and the helix connected with the battery, the bar was drawn down into the helix with a force of six pounds, as indicated by the spring balance. This balance is sensitive to the $\frac{1}{2}\frac{}{0}$ of an ounce, and when dealing with pounds, may be considered as sufficiently accurate. The hollow bar No. 2 was then substituted for bar No. 1, and was drawn down by a force of three pounds and a fraction over, the fraction doubtless arising from some difference in the textures of the two bars. We are thus furnished, by this satisfactory and practical test, with a definite law of inductive action, viz.

The inductive action of a helix upon inclosed bars of soft iron of uniform lengths and transverse diameters, is directly in proportion to the weight of those bars.

The bar No. 3 was then inserted, and it was drawn down by a force of five pounds and one ounce; but here the result became complicated, and will require further trials with many variations of length and also diameter of the soft iron bars. It probably would not follow that the indefinite increase of weight by increase of length would give a proportionate increase of inductive action, for there must soon be a limit for every size of bar, and this limit will vary with the different sizes. The experiments as tried, however, are in favor of the conclusion that the action is as the *mass*, and not the *surface*. One experiment remains yet to be tried in this connexion, for which I have not yet had opportunity, viz. to make the masses the same, and vary the diameters. The result here also would be complicated by the element of the distance.

The second investigation was directed to the law of Ampère, viz. that the action of helices upon a magnetic bar, is inversely as the distance. The same law of course applies to soft iron as to permanent magnets. The law was fully confirmed. Great care was taken in the preparation for these experiments. The helices before mentioned were all wound upon steel mandrels, carefully turned and polished, and all of the same length of wire. The bores of three helices regularly increased in diameter $\frac{1}{2}\frac{1}{6}$ of an inch. When these helices were placed in succession upon a bar of soft iron, they gave by the balance, forces inversely proportional to the distance.

ART. XVIII.—*On the probable Conduction of Galvanic Electricity through Moist Air;* by CHAS. G. PAGE, M. D., Prof. Chem. and Pharm., Columbian College, Washington, D. C.

SEVEN or eight years since, I observed a curious fact, which led me to the conclusion that many substances considered as perfect insulators, or rather non-conductors of galvanic electricity, might under certain circumstances prove conductors. I took two large sheets of zinc and coiled them together, the two sheets being separated by a layer of India rubber cloth. The sheets of zinc were connected, respectively, with the poles of a battery, and when the battery consisted of a single pair, no appreciable

current passed from plate to plate through the India rubber cloth. When however the battery consisted of twenty compound pairs, a slight current passed, as indicated by a delicate galvanoscope. I made no further investigation or application of this fact till 1843, when recurrence was had to this feature to solve some difficulties experienced in the projection of a line of Morse's telegraph between this place and Baltimore. Ten miles of lead pipe containing four well insulated wires had been laid in the ground, and upon trying these wires respectively, making the wire one half of the circuit, and the lead pipe the other half, with a battery of intensity, a current could be established through any one of the three *extra* wires. Being consulted by Prof. Morse as to the probable cause of this *cross firing* as it was technically called, the solution seemed to me to be obvious in view of the above experiment. The reasoning was sufficiently plausible to induce Prof. Morse to abandon the undertaking of the pipe, and resort to his original plan of raising the wire upon posts. The explanation was simply this, viz. that the insulating or non-conducting material would under any circumstances conduct the current; but in some cases, the amount transmitted could not be appreciated by any known test however delicate, was a *postulate* subsequently borne out. Does not such a conclusion follow directly from the law of Pouillet, that the conducting power of wires is directly as their cross section and some inverse ratio of their length, in connexion with the well established laws of the different conducting powers of metals? For example, copper having from four to six times the conducting power of iron, a wire of iron, to equal in this respect a wire of copper, should be of from four to six times the size. Let this rule be applied to poorer conductors, and we may infer that the poorest conductor, or what has been usually considered a non-conductor, would become a conductor, if the area of its cross section were indefinitely increased and its length remained nearly nothing. In the case of the wires in the lead pipe—the one for instance joining the two poles of the battery—is separated from that lying next to it and the lead pipe, by a layer of thin non-conducting material throughout its length; and if we suppose the width of this layer in contact to be $\frac{1}{8}$ of an inch, the length of ten miles would give a surface of 550 square feet, while the length of the conductor would be only the thickness of the material, and a constant quantity,

for any length of wires and tube, and increase of surfaces in contact. A full realization of the principle appears in the fact, that although the earth is a much poorer conductor than copper, mass for mass, yet upon the telegraphic routes, it is found that the earth is a much better conductor than the copper wires used, the mass of the former being indefinitely greater than the latter.

These phenomena induced me to try the following experiment, in order to ascertain if the air might not act as a conductor. The roof of the patent office building covered with copper, exposes to the air twenty-two thousand square feet of this metal, and thus affords an enormous surface for conduction. A wire was connected with the metal of the roof, another wire with a plate of zinc of about four square feet. The free ends of these two wires were connected with a galvanoscope of exceeding sensitiveness, and with matters thus arranged, the zinc plate was insulated from the earth and building, in the open air, and when the upper surface of the zinc plate was moistened with water or what proved still better, acidulated water, the needle of the galvanoscope was deflected from two to five degrees. There was a slight drizzling rain at the time. Before the zinc plate was moistened no action was noticed. The inference from this experiment seems safely to warrant the position that a moist atmosphere conducts galvanic electricity. Many years since, I proposed in this Journal a plan for ascertaining the level of the water in steam boilers consisting of a zinc plate or a pair of plates, which should indicate the failure of water in the boiler by the cessation of action upon a galvanoscope placed in any convenient position outside the boiler. I have never had opportunity to test this device, but was at the time somewhat apprehensive that pure steam might act as a conductor and thus defeat the invention. I have recently been informed, though not in a direct manner, that the experiment had been tried in Philadelphia and that the steam acted as a conductor. Whether dry air could act at all as a conductor remains yet to be ascertained, and I shall be able soon, to put it to the test. Immediately after the above experiment was tried, the zinc plate was buried in the earth, other things remaining the same. The galvanoscope is inside a window in the second story, where I am enabled to watch it through most of the day. To my surprise as soon as connexion was made with the plates, one being the copper roofing, and the other buried verti-

cally in the earth, the needle was deflected forty degrees, and the quantity of electricity afforded was sufficient to operate the magnets used in Morse's telegraph, as witnessed by the Professor, and others present. Is the conduction through the material of the building or through the earth and intervening atmosphere? Probably through the mass of the building, which is constructed of blocks of sandstone, the walls being $2\frac{1}{2}$ ft. in thickness. A small piece of this stone was found not to conduct this current perceptibly, either dry or when moistened with water. But when moistened with acidulated water, the current passed feebly. The fact is interesting whether the air or sandstone becomes the conductor; for if the conduction be through the building, it is through a material which in a block of eight or ten cubic inches, is apparently a non-conductor, but which in the aggregate of the immense pile of the edifice is a conductor. The extreme sensitiveness of the galvanoscope is evident from its frequent disturbances from the slightest causes. I may safely say that the needle is affected by a flash of lightning one hundred miles distant. Whenever a thunder cloud is visible, the needle is deflected at each flash of lightning, and the deflection is in one or the other direction, as the induced current varies according to the direction of the lightning. When the thunder cloud is near, the action upon the needle is very strong and has several times twisted it suddenly off from the silken fibre to which it is attached. When no cloud is visible in the horizon, the needle on certain days—particularly at noon when thunder storms most frequently occur—is subject to frequent disturbances, resembling the former. I may remark here, as evidence of the rapidity of induction, the movement of the needle and flash of lightning appear simultaneous to the eye.

There are some extraordinary influences upon the needle, having a kind of periodicity, which cannot yet be accounted for, or identified with any meteorological fluctuations. There are also regular changes, which have thus far been noticed during the day. In the morning the current is at its maximum. About 10 o'clock A. M. it declines, and gets to its minimum about half past 2 P. M., when the needle begins to return and arrives within four or five degrees of its maximum of deflection at 8 P. M. Whether this point observed at 8 A. M. is the real maximum is not known, as I have not been able to observe it in the night. The range of variation from morning to night is about ten degrees. I have not

been able to notice any irregularity in these changes except as to the time. The irregular disturbances are very interesting, and may be identical with the *magnetic storms* of Gauss. Upon certain days they are hardly perceptible, though they never cease altogether. On some days they are violent, if I may be allowed the expression. The needle does not take a sudden start and return as when influenced by lightning, but moves gradually without oscillation to some fixed point, from which it will return sometimes in two minutes and sometimes in ten or fifteen minutes. An extended series of observations will be necessary before any deductions can be safely made. If the wires should be separated by a slight interval during a thunder storm, doubtless electrical sparks would be visible. During heavy storms, a flash of lightning twenty miles distant from the wires of Morse's telegraph will induce electricity in the wire sufficient to operate the magnets, and work the telegraph, sometimes recording several signals. A flash of lightning in Baltimore, forty miles distant from this place, will operate the magnet at this end of the line.

Washington, D. C.

Appendix.—Mr. Lane remarks, in his communication on the electric conduction in metals,* that in his experiments he found no confirmation of the statement made in this Journal† a few years since, "that the conducting power of a wire is greatly impaired by bending or twisting it." Mr. Lane has somewhat magnified my meaning by introducing the word *greatly*, which I did not use, and it is probable that he has really confirmed my statement, as he remarks, that after winding and unwinding a thick wire several times over a cylinder less than an inch in diameter, the conducting power appeared scarcely affected, implying that some effect was produced; and if in Mr. Lane's ingenious and well arranged experiments, which were made with only a few feet of wire, he found even the slightest loss of conducting power, it is reasonable to suppose that in many hundred feet of wire the loss would be a very notable quantity. A statement which I also made in addition to the above, should have been explained. The statement was that "a wire which has once been wound upon a magnet is not fit for the same purpose again." There are

* See this Journal, Second Series, i, 230.

† See this Journal, First Series, xxxv, 109.

two reasons why such wire would not answer as well as before. *First*, its conducting power would be impaired, and *secondly*, it is extremely difficult to straighten such wire, so as to wind the several turns as closely as before. In regard to the tables which have heretofore been made for the relative conducting powers of different metals, it must be observed, that they cannot be regarded as any thing more than approximations to the truth. What is true of many practical applications of science, is particularly so of galvanism, viz. that laws, rules, or principles deduced from miniature experiments, have entirely failed when applied to operations upon a large scale. As for instance, the law of Pouillet, that wires conducted directly as their cross sections and inversely as their length, was admitted until the experiments in telegraphic operations upon hundreds of miles of wire, disproved this law and confirmed the law of Ohm. I have some interesting facts hereafter to be communicated, showing the importance of operations upon grand scales, in establishing general principles. Most of your readers will remember the signal discovery of Liebig of the existence and economy of ammonia in the atmosphere, which he owed to his departure from the limited eudiometrical experiments of other philosophers and investigating large quantities of air instead of small. The effect before alluded to of bending and twisting wires is much more apparent in some species of wires than others. There has been a spurious copper wire now for some time in the market, and it has been my misfortune to purchase about ten thousand feet of it.* Its conducting capacity as measured by the *axial galvanometer*, in lengths of 1000 feet, is about one-third less than pure copper wire. It is well known that a wire may soon be broken by bending it back and forth for a few times. Each bend of course approaches to this solution of continuity, and must interrupt that integrity of molecular arrangement which is essential to good conduction. Now a few such short bends may not be appreciable by ordinary tests, but when multiplied several hundred times, the resistance to the current becomes of sufficient moment to be a subject of attention. C. G. P.

Washington, D. C., July 3d, 1846.

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* It is the same wire that has so perplexed the telegraphic operations between New York and Philadelphia, breaking almost daily merely by its own weight.

Art. XIX.—*Eocene Formation of the Walnut Hills, &c., Mississippi;* by T. A. Conrad.

The elevated bluffs on the Mississippi above New Orleans, on which stand the towns of Natchez, Rodney, Grand Gulf, and Vicksburg have a similar geological origin, and these interesting hills present sections of two formations or depositions widely different in age, as well as in the phenomena presented to our notice and in the causes which produced them. The lower strata are wholly of marine origin, and as I stated in a former publication, they are members of the Eocene, admirably characterized by the peculiar forms which existed in the seas of that period. The shells are extremely abundant, and as in all other localities of the Union which have been explored, the line of demarcation between this formation and the Miocene is as strongly marked as a total diversity of species can make it. My investigations during a late tour in Mississippi, have been chiefly confined to the vicinity of Vicksburg. The hills here rise steeply from the Mississippi river and are some miles in extent. They have been washed into frequent and sometimes very profound ravines which cut through and expose the Eocene strata, and the sides of the hills and ravines are whitened in many places by the shells which have been washed out of the ferruginous marl or fossiliferous mixture of sand and clay. The strata appear to be nearly horizontal and the greatest elevation about sixty feet above the ordinary high-water level. The lowest stratum exposed is a bluish compact limestone, which is quarried for the purpose of paving the streets of Vicksburg. It is full of shells and casts of shells of such species as are common in the marls above. One of the most abundant bivalves is *Pecten Poulsoni*, (Morton,) a species occurring in the white limestone near Claiborne, Alabama. A very thin wafer-shaped Nummulite, described by Dr. Morton, is common in the limestone as well as in all the strata above, and connects the formation of Vicksburg with the Eocene white limestone of St. Stephen's, Alabama. A new species of *Pinna* is one of the most striking fossils of the limestone at Vicksburg, and which is rare above it. Over this rock are various strata of sandy marl, sometimes indurated and ferruginous, clay, and clay and sand mixed, all of which are very prolific in fossil shells.

Near the summit of the Eocene are beds of coarse gravel mixed with whole shells and fragments, from which many fine agates have been procured by Mr. Anderson of Vicksburg. These strata do not appear to have been much disturbed or inclined by the force which elevated them to their present level. The group of fossil shells though as strongly marked in its Eocene character as any in the Union, is yet remarkably distinct from that of Claiborne or of any other locality which I have seen, as out of about sixty-two species, thirty-eight are new, and I am confident that ten species will on comparison be found identical with Claiborne shells. In most of the strata here, small and large fragments of shells are very abundant, some of which are water-worn and others not in the least abraded. Occasionally we find a black water-worn shell just in the proportion to the others as we see them on the sea beach of New Jersey. The vicinity of an ancient sea beach is strongly indicated by the phenomena of these strata, which is not the case at Claiborne. Bivalves with connected valves are rare, fragments abundant, and the many water-worn specimens all tend to prove the action of the surf. In the clay stratum of the upper portion of the formation, the shells in some rare instances retain a trace of their original colors and their polish is fully equal to that of recent shells, though they become chalky on exposure to the sun. The large *Cardita planicosta*, which so generally prevails in Eocene deposits, is unknown here, and the *Crassatella alta* of Claiborne is also absent, but there is an allied though very distinct species. There is one bivalve here, a new *Panopæa* which is common, and yet unlike the other bivalves is almost in every instance entire, and placed vertically in the strata, just as it occurred when living and burrowing in the bed of the sea. It therefore lived and died on the spot where it is now found, whilst nearly every other shell had been abraded by the surf or transported by currents. This is precisely the case with all the various species of *Panopæa* in the Miocene formation, and it is clear that they burrowed deeply in the mud or sand beyond the influence of the agitated waters which scattered the various shells at that time existing near the surface.

The principal development of the Eocene is north of Vicksburg, and every ravine cuts through its various strata, but it is almost impossible to procure an accurate section of them, as they are universally sunk and displaced by land slides and subsidence.

As near as I could ascertain, the Eocene strata rise to a level of sixty feet above the river when there is an ordinary freshet. The limestone, nearly on a level with the water, is the lowest stratum known, as debris and deposits from the river cover and conceal whatever may be at a lower level. At the plantation of Dr. George Smith, five miles northeast of Vicksburg, a ravine cuts through the Eocene strata and exposes about the same elevation of horizontal beds, and between them and the loam with land shells, is a stratum of loam with coarse gravel without a trace of organic remains. This gravel is also visible at Vicksburg, but the thickness of it, or its relation to the Eocene is not yet determined.

The only abundant shell of the Vicksburg Eocene, common also at Claiborne in Alabama, is *Dentalium thalloides*. It is probable that the deposits of the Walnut Hills were made in shoaler water, and nearer the shore of the Eocene ocean than those of Claiborne, but it is remarkable that no species of *Cerithium* occurs, a genus so abundant in species in the Eocene of France, and which is supposed, where it abounds in a fossil state, to indicate an ancient estuary.

Vicksburg Fossiliferous Loam.

Above the Eocene of Vicksburg, Grand Gulf, Rodney and Natchez, there is a thick deposit of loam of uniform composition and appearance, which is at least fifty feet thick in many places, and probably much more in others; but owing to land slides and the vast accumulation of debris between this loam and the Eocene, the depth of the former is uncertain, and there may be a distinct deposit between the two. The loam is apparently identical in composition with the cane-brake lands of the Mississippi, and abounds in land shells of such species as exist plentifully in the alluvial flats subject to the overflow of freshets. I have collected *Helix thyroidus*, *H. ligera*, *H. concava*, *H. setosa*, *H. arborea*, *H. perspectiva*, &c., together with *Succinea ovalis* and *Helicina orbiculata*. Of fresh water shells, there is a small *Cyclas* and *Paludina* which I have not seen in the rivulets near Vicksburg, though two other species of *Cyclas* abound in one of these small streams. The fossiliferous loam has a very undulating summit line, following the outline of the innumerable hills, and it is covered by six to eight feet of a different kind of

earth, in which no shells occur. No gravel is mixed with either of these strata, but calcareous concretions abound in the lower stratum of loam with shells. I am indebted to the polite attention of Dr. E. H. Bryan, who resides near the Jackson rail road, nine miles east of Vicksburg, for an opportunity to make some interesting explorations in his vicinity. We visited one of the numerous horseshoe lakes formed by the rivers' deserting old channels and seeking a new course. We passed through a tract of alluvial land still subject to be overflowed, and in one of the rivulets collected two species of *Cyclas* which are not seen in the fossiliferous loam. The land shells, on the contrary, are precisely of such species as abound in it, and occur plentifully under logs and dead leaves in the woods, where they must be subject to be killed by freshets and buried under the deposit left by the retiring waters. Almost as soon as the freshet subsides, another generation of these shells exists here, and thus as the deposition goes on, the land shells are distributed throughout the alluvium to a great depth precisely as they are in the fossiliferous loam of the hills. In the rivulets the Cyclas exists, and is carried out by floods and distributed among the land shells, but they are rare in comparison with the latter both in the fossil and recent state. In the numerous *cut-offs* or lakes *Unios* and *Paludinas* abound, and these are represented in the ancient deposit by the beds of similar shells, all of existing species, which occur in patches everywhere throughout this singular region. They always occur in a black soil, evidently once the bed of lakes, and entirely different in color and consistence from the loam containing land shells, and they are always at a much lower level than the top of the latter deposit. One of these beds of the fossil Unio we observed near Big Black river, which though much below the surface of the hills of fossiliferous loam, is yet at an elevation of about fifty feet above the river when the water is moderately high. Among these shells I noticed *Unio cicatricosus* and *Paludina ponderosa*. In the bluff near Vicksburg and on Dr. Smith's plantation northeast of the town, *Unio quadrulus*, Raf., was the most common species observed. The identity of the fossiliferous loam with the alluvium of the Mississippi, is confirmed by a singular phenomenon in the nearly perpendicular banks formed by cutting through hills on the line of the Jackson railroad. Dr. Bryan called my attention to the willow and cottonwood trees, which

have their roots in the summit line of the fossiliferous loam, eight feet beneath the surface of the hills. These are the kinds of trees which first take possession of the soil made by deposition from the Mississippi near its mouths, and which refuse to grow on the hills above the loam or in the earth which overlies it. These trees grow only on the summit line of the loam, following all its undulations, and many are of such a size that they are evidently nearly as old as the excavations which have given them a chance to spring up. The railroad has been made about ten years, and Dr. Bryan assures me that the trees made their appearance soon after the hills were cut through. The seeds or roots must therefore have been in the newest deposits of loam, and it is evident that no vegetation, except canes or reeds, occupied the soil before its latest deposition, at which latter period it is probable that the willow, cottonwood, and other trees, first made their appearance on the earth, and perhaps the mastodon, elephant, hippopotamus, &c., came into existence at the same time, since the remains of the mastodon and elephant have been abundantly found in the vicinity of Natchez and Vicksburg, though I have not ascertained in what part of the stratum they occur. The foregoing facts and observations have led to the inference that all this thick and elevated deposit, with land universally distributed through it, was the result of ancient floods in the Mississippi and its tributaries. The cause, whatever it may have been, which elevated the Eocene strata of the Mississippi bluffs, raised at the same time this ancient alluvium, and thus the uprise of the tertiary may be referred to a very modern period, and one which seems to have been connected with the causes which destroyed the mastodon, elephant, hippopotamus, &c. which once existed in North America. It is difficult to account for the origin of the peculiar earth above the fossiliferous loam, or to assign a cause for the undulations of the surface of the latter, which conforms to the slopes of the innumerable hills in this country, where there is no level ground except that subject to floods from the rivers. It is certain, however, that the lakes are numerous, their shores steep and high, and that a future elevation of the country would present a large proportion of steep declivities, having their origin in the present sloping shores of the cut-off lakes which are common near all the rivers, where they approach the Mississippi.

There seems to be no other theory than the one I have suggested which can account for the origin of the fossiliferous loam.

A lacustrine origin is out of the question, because such an universal diffusion of land shells with no fresh-water shells among them, except *Cyclas* and small *Paludinæ*, could under no circumstances take place in a lake of considerable size. In that case, Unios and large fresh-water shells would be the predominant fossils, and land shells of rare occurrence. Admitting the loam to have been deposited by the overflows of the ancient Mississippi, it assumes a feature of extraordinary interest in proving a considerable elevation of the Eocene strata in a period as recent as that when the mastodon existed. This rise of land, I have no doubt, was coeval with that of the Gnathodon beds of Florida, Alabama, and Louisiana, of the keys of Florida, and of the oyster shell deposits of Virginia, Maryland, and New Jersey. At this time the change of climate occurred which has restricted the living Gnathodon to the estuaries of the Gulf of Mexico, and which was probably connected with the disturbance or revolution that exterminated the mastodon and its gigantic associates.

ART. XX.—*Notice of a small Ornithichnite;* by C. B. ADAMS, State Geologist of Vermont, &c.

THE specimen from which the following figures were drawn, was obtained in Wethersfield, Ct., at the locality of Ornithichnites described in the Final Report on the Geology of Massachusetts, pp. 466–7, and with many others from the same locality, is now in the cabinet of Middlebury College, Vermont. It is a fine red slate of the new red sandstone. The tracks here figured are in relief, the specimen having the corresponding impressions not having come into the possession of the writer.

Fig. 1.

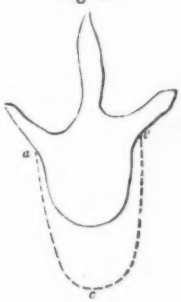


Fig. 1 appears referable to the species *Argoides minimus*, Hitchk.* This animal appears to have had slender toes, but a broad heel, like *Polemarchus gigas*, Hitchk.,† which, as in that case, indicates a much heavier animal than would have been supposed from the slenderness of the toes. These two animals, so

* Proceedings of Sixth Meeting of Association of American Geologists, p. 24.
† Ibid.

extreme in size, may possibly have been more nearly related than has commonly been supposed. The dotted line *a c e* includes the slope of the depression made in the plastic stratum around the heel.

Fig. 2.

But the principal object of this notice is to call attention to the small track, fig. 2. It is near the larger track in the slabs which show their relative position, and is quite moderately depressed. From its general resemblance in form to the other track, it seems probable that it was made by an animal of the same species. The difference in the form of the toes may be readily accounted for by the want of an exact proportion between the width of the toes and that of their tracks, and by differences of the former consequent on difference of age. As the extremities of the impressions of the toes are sharply defined, it cannot be supposed that the track is imperfect in front. The posterior portion of the heel is less distinctly defined, and the whole heel was less deeply impressed, the deepest part of the track being represented by the dotted line *n*. This corresponds with the general character of *Argoides minimus*, as described by Pres. Hitchcock, "heel rarely making an impression"—our fig. 1 representing a track of the heel very remarkable for the depth and size. In pl. 42, fig. 35, of the Final Report above quoted, we see several tracks of the same size with the small specimen, fig. 2, but without the heel. The discovery of the latter in one of these small tracks, strengthens the conclusion that they were made by the *Argoides minimus*.

Art. XXI.—*On the Discoidal Stones of the Indian Mounds;* by E. G. Squier.

In the paper contributed, by Dr. Morton, to the last number of the American Journal of Science,* reference is made to certain "discoidal stones," some of which are figured. Exact counterparts of these stones, are in the possession of Dr. Hildreth of Marietta; in fact, they occur in considerable numbers, all over Ohio, and may be found in the cabinets of almost every collector of aboriginal remains. After extensive exploration, I have reason to think it extremely doubtful whether discs of this description were ever found in the mounds, except in cases when they were depos-

* Second Series, ii, 1.

ited by the modern (existing) race of Indians. The stones met with in a mound near Chillicothe, to which Dr. Morton alludes, are very unlike those figured in his paper, as they are of horn-stone, rudely blocked out, while the others mentioned, are of great symmetry and manifestly the result of much labor.

Nor is there, apparently, much mystery as to the use made of these stones. I am assured, by Rev. Mr. Finley, "the Wyandot Chief," (distinguished for his zealous efforts in christianizing the Indian tribes of Ohio,) that among the tribes with which he was acquainted, stones of this description were much used in a popular game, somewhat resembling our game of "ten pins." A smooth and well packed area of earth was selected, at one extremity of which a small wooden pin was stuck, while the player stationed himself at the other. The point of the game consisted in striking the pin oftenest in a given number of trials. The form of the stones suggests the manner in which they were held and thrown, or, rather, rolled. The concave sides received the thumb and second finger, the forefinger clasping the periphery.

Adair, in his account of the Indians along the gulf,* gives a minute, and graphic account of a game, somewhat analogous to that described by Mr. Finley, in which stones of this description were used. He says:—"The warriors have another favorite game, called *Chungke*; which, with propriety of language, may be called "Running hard labor." They have near their state house, a square piece of ground well cleared, and fine sand is carefully strewn over it, when requisite, to promote a swifter motion to what they throw along the surface. Only one or two on a side, play at this ancient game. They have a stone about two fingers broad at the edge and two spans round; each party has a pole about eight feet long, smooth and tapering at each end, the points flat. They set off abreast of each other, at six yards from the edge of the play ground; then one of them hurls the stone on its edge, in as direct a line as he can, a considerable distance towards the middle of the other end of the square: when they have run a few yards, each darts his pole, anointed with bear's grease, with a proper force, as near as he can guess, in proportion to the motion of the stone, that the end may lie close to the

* "History of the American Indians, particularly those nations adjoining to the Mississippi, East and West Florida, Georgia, &c. by James Adair, London, 1765."

same—when this is the case, the person counts two of the game, and in proportion to the nearness of the poles to the mark, one is counted, unless, by measurement, both are found to be an equal distance from the stone. In this manner the players will keep moving most of the day, at half speed, under the violent heat of the sun, staking their silver ornaments, their nose, finger and ear-rings, their breast, arm and wrist plates, and all their wearing apparel, except that which barely covers their middle. *All the American Indians* are much addicted to this game, which appears to be a task of stupid drudgery; it seems, however, to be of early origin, when their forefathers used diversions as simple as their manners. The hurling stones, they use at present, were, from time immemorial, rubbed smooth on the rocks, and with prodigious labor; they are kept with the strictest religious care, from one generation to another, and are exempt from being buried with the dead. They belong to the town where they are used and are carefully preserved."—*Adair*, p. 402.

Dr. Morton is, I think, mistaken in supposing the occurrence of these stones to be circumscribed. They certainly occur throughout the west, as do also, the spheroidal stones mentioned, which, it is quite evident, were used for similar purposes.

It will be seen, from the above, that Dr. Blanding was right in his suggestion, that these stones were used in the games of the aborigines.

Chillicothe, Ohio, July, 1846.

Art. XXII.—*Chemical Examination of several Natural Waters;** by B. Silliman, Jr.

It is nearly a year since the analyses here tabulated, were made and published in the document, whose title is given below. No mention however has been made of them in this Journal, and we now propose, to give only the scientific results in a condensed form and with the omission of much detail which was proper to the pages of the 'Report.'

The writer received the water in samples of two or three gallons in well stopped glass bottles, and designated by numbers only. It was supposed that they were all the product of a gran-

* Report of the Water Commissioners, 1845. Boston City Document, No. 41, 8vo. pp. 160, *Appendix*. Report on the Analysis of the Waters, by B. Silliman, Jr.

itic region, which was not however the case. The waters examined were severally as follows.

Water No. 1. From Mystic Pond, near Boston, about 60 rods above the outlet, taken from the surface, 100 to 150 feet from the shore, where the depth was more than 10 feet, collected August 16, 1845.

No. 2. Croton River, N. Y. taken from the upper reservoir, City of New York, near the S. E. corner and near the outlet leading to the distributing reservoir, collected August 25.

No. 3. Spot Pond, taken July 17th, 150 to 200 feet from the proposed outlet of conduit, and from the surface,—over a depth of 13 feet.

No. 4. Schuylkill, Philadelphia, collected Aug. 23d, 100 to 200 feet above the fore-bay in the pool of Fairmount dam.

No. 5. Long Pond, Mass., collected July 19th, from the point of exit of proposed aqueduct, 150 to 200 feet from shore. Taken from the surface where the depth was 10 feet.

No. 6. Charles River, Watertown, Mass., collected July 29th, 150 to 200 feet above the lower dam, in the middle of the stream.

No. 7. Charles River, South Natick, Mass., collected July 22d, in the middle of the pool, and 200 feet above the dam.

No. 8. Spot Pond, Mass., between the island and southeast shore, at 9 and 13 feet depth from the surface, collected Sept. 3d and 6th.

No. 9. Long Pond, Mass., upper division, from a depth of 62 feet, collected Sept. 8th.

No. 10. Spot Pond, Mass., 26 feet depth—same locality as No. 8—collected Aug. 26th.

No. 11. From a well on the premises of James K. Mills, Esq., No. 20 Beacon street, Boston; taken Oct. 13.

In *color and transparency*, these waters range almost exactly, in the order of their numbers. No. 1, being most transparent and No. 10 least so. No 11 was a very clear water. Nos. 8, 9 and partcularly No. 10, were very deep brown colored waters. No. 10 looked like an infusion of tan bark or weak coffee, and had a copious brown precipitate, like hydrate of iron at the bottom. In *taste*, they were generally good and sweet. No. 1 was however brackish and saline, and No. 11, quite nauseous, from the amount of common salt and magnesian and lime salts it contained. The highly colored water, No. 10, was not disagreeable in taste, while No. 2, (the Croton,) had a decidedly swampy flavor.

Numerous animalcules were observed in most of them when first examined and Prof. Baily detected in samples sent to him, nearly all the common forms of soft and hard shelled polygastric

infusoria, usually present in the sweet waters of our ponds and rivers. Water which will not support the life of these delicate creatures is not fit for human use. For a list of these, see the copy of his letter in the report in question.

Only Nos. 1 and 11 were decidedly *hard* waters. The others were generally quite soft.

The general course of analysis was in most respects, similar to that usually pursued. A full qualitative examination was first made, to determine the number and comparative abundance of the foreign matters.

This examination showed that the waters were all neutral except, Nos. 5, 6, 9, 10, and 11, which contained an appreciable quantity of crenic and apocrenic acids. The *carbonic acid* was determined by Berzelius's mode, on a separate quantity, and the *sulphuric acid* was subsequently estimated on the same portion. No ammonia was detected in any of them.

The solid contents were determined by evaporation to a small bulk, of a carefully measured standard gallon of each, in capacious glass flasks, and the evaporation was completed in counterpoised capsules of platina or porcelain. The subsequent ignition of these capsules gave us the amount of matters volatile at redness. The ultimate analysis of the solid contents was divided into two parts, that soluble in boiling water, and the insoluble residue.

The *phosphoric acid* was determined by a re-solution of the ammoniacal precipitate of alumina, iron, &c. in pure acetic acid. If an insoluble residue remained, it was collected, weighed, and then separately analyzed to determine with entire certainty the presence of phosphoric acid. For this purpose the supposed phosphates (of alumina and iron) were fused with one part of silica and six parts of pure carbonate of soda, for half an hour, in a crucible of platinum. The fused mass, treated with water, was filtered, and the silicic acid removed from the filtrate by digestion with carbonate of ammonia and evaporation to dryness. The neutralized filtrate was then treated with nitrate of silver, which promptly threw down the characteristic precipitate of yellow tribasic phosphate of silver, blackening by light, and wholly soluble in dilute nitric acid. This is the method advised by Berzelius for the separation of alumina from phosphoric acid, and no better proof can be required of its presence. The occurrence of *phosphoric acid* in water has generally been overlooked, because unsuspected. It has escaped under the general title of alu-

mina and iron, with which it is thrown down on addition of caustic ammonia. It is certainly interesting to observe that a compound indispensable to the full development of the human frame, should be so widely diffused as to be present, in minute quantity, in almost all natural waters. We are less surprised at this fact now than we should have been a few years ago, since we now know that phosphoric acid is found in granite, mica slate, various limestones of all formations, as well as in many simple minerals where it had before been overlooked; the writer has also detected its presence in connection with *fluorine*, in most recent corals and coral limestone*—and Dr. Jackson informs him that in the analyses of sea waters for the Exploring Expedition, he also detected phosphoric acid.† It is also a fact of significant interest, that *silica*, in its soluble modification, should be found as an almost constant ingredient of natural waters.

The *nitric acid* was determined quantitatively, only in one instance, but its presence was very evident in several of these waters, from the rapid deflagration of the residue of evaporation, on ignition. It is worthy of remark that in all cases where this deflagration was observed, the residue was found to be strongly alkaline, and to effervesce on the addition of a dilute acid: the carbonate of soda and potassa being formed from the decomposition of the nitrates and crenates of these bases.

Table I presents the general results of the evaporation of one gallon of each water: and the estimation of the quantity of carbonic and sulphuric acids in the same quantity.

Number of water.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Solid matter in 100,000 parts by weight,	50·752	18·714	3·647	9·417	3·168	5·702	4·332	5·308	5·770	10·598	87·85
Grains of solid in 1 gallon,	39·710	10·93	2·13	5·50	1·85	3·40	2·53	3·10	3·37	6·19	51·274
Volatile at redness,	6·02	4·28	0·86	1·24	0·63	0·85	0·86	1·00	1·16	1·58	1·218
Leaving solid matter,	33·68	6·66	1·25	4·26	1·22	2·55	1·668	2·10	2·21	4·62	50·055
Of which there was soluble in hot water,	32·45	2·49	0·69	0·57	0·53	0·93	0·758	0·79	0·48	0·73	
Insoluble,	1·24	4·47	0·56	3·69	0·69	1·62	0·910	1·31	1·73	3·89	
Volume per gallon of carbonic acid,(in cubic inches)	10·313	17·418	9·516	3 879	10 719	5·058	0 464	5·163	4 549	a trace	35 04
Sul. acid in one gallon,	·1058	·0055	0·0824	0245	·0044	·010	0·0137	·011	·0037	0·0246	4·968

* See this Journal, Second Series, i, 189.

† In this connection I may also mention, that my assistant, Mr. T. S. Hunt, has lately at my request, examined the sea waters of Long Island Sound taken up at this place, (New Haven, Ct.) and has found decisive evidence of the presence of phosphoric acid. The quantity operated on was not sufficient (about sixteen gallons) to give evidence of fluorine and boracic acid, which we cannot doubt do exist—but in exceedingly small quantity—in sea waters. We were led to these examinations by the coral analyses before alluded to.

In reconstructing the supposed condition of the various ingredients, found as they *probably* existed in the waters, the rule adopted has been, to follow as nearly as possible the order of affinities of the various elements concerned, and to regard also that partition of acids among bases which undoubtedly obtains in nature. It is indeed the opinion of Berzelius, Rose and other eminent chemists, that the effort to restore with accuracy the precise condition of the elementary combinations concerned in a mineral water, is altogether futile—except in cases of extraordinary simplicity; and that it is the better way to state only the quantities of the various ingredients found, and leave it for the ingenuity of the student to reconstruct them as he finds most convenient. In my analysis of the waters of the Dead Sea I have followed this principle.*

It was however in the present case required, from the popular nature of the report in which these analyses appeared, to state them in the more usual form. Table II shows the reconstructed condition of the analyses of ten of the waters, while No. 11 is presented by itself.

TABLE II.—Showing the composition of the fixed residuum of one gallon of each water.

	M. P.†	C.	S. P.	S. R.	L. P.	C. R.	C. R.	S. P.	L. P.	S. P.
Number of water,	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Chloride of sodium,	27·9111	·167	0·3969	·1470	·0323	·1984	·1547	·1553	·2540	·2230
Chloride of potassium,	·1590	. .	. .	. .	·0380					
Chloride of calcium,	·1544	·372	. .	. .	·0308	. .	·0420	·0044		
Chloride of magnesium,	. .	. .	. .	·0094	·0764	. .	. .	. .	. .	·0144
Chloride of aluminium,	. .	·166								
Sulphate of potassa,	. .	. .	. .	. .	. .	·0310				
Sulphate of soda,	. .	·153	0·2276	. .	. .	·0830	·3816	·1510	·0843	
Sulphate of magnesia,	1·9768	. .	. .	·0570	.1020	·1350	. .	·1290	. .	·0570
Sulphate of lime,	·1219	·235	. .	. .	. .	·6810 and silica	·2624 and silica	·4940 and silica	·5700 and silica	2·0700 and silica
Sulphate of alumina,	·4478	. .	. .	. .	. .	. .	. .	. .	·0146	
Phosphate of alumina,	.2810	·832	. .	. .	. .	·0830	·0973	·0740	·1700	trace.
Alumina, iron, and phosphate do.	. .	. .	0.1081	. .	. .	. .	. .	. .	. .	1·3600
Alumina,	. .	. .	. .	. .	·0800					
Silica,	·5559	·077	. .	·0800	·0300					
Carbonate of lime,	·1698	2·131	0·3722	1·8720	0·2380	·4970	·1610	·0490	·3860	·3410
Carbonate of magnesia,	·9894	·662	0·1420	·3510	.0630	·1300	·0399	·1030	·2560	·2930
Carbonate of soda equal to nitrate and carbonate of do., and loss,	. .	1·865	. .	1·6436	·5295	·7116	·5291	·9403	·4757	·2816
Total,	32·7671	. .	1.2468							
Actual amount after ignition,	33·6833	6·66	1·2500	4.2600	1·2200	2·550	1·6680	2·1000	2·2100	4·62
Loss,	·9162	. .	0·0032							

It will be seen that these tables afford us the means of comparing the respective purity of different samples of the same water, taken from various positions and depths. The general result

* American Journal of Science, First Series, xlviii, 10.

† M. P., Mystic Pond.—C., Croton River.—C. R., Charles River.—S. P., Spot Pond.—S. R., Schuylkill River.—L. P., Long Pond

is, that the surface water of lakes is purer than that taken from some depth. Nos. 3, 8, and 10, also 2, 6, and 7, also 5 and 9, offer illustrations of this remark. The rivers also gather impurities as they draw near their mouths, the water from high up the stream being purest. It will also be seen that the number and proportion of the ingredients vary in the same water. These results were not a little interesting to the writer and his excellent assistant, Mr. Hunt, when after our labors were closed, we were for the first time supplied with the names of the various sources from whence the waters on which we had labored were obtained.

The specific gravities of these waters were taken with a delicate balance, and with every precaution as regards temperature, &c. A glass bottle with a perforated stopper was used for the purpose. The results were in some cases anomalous, giving for some of the waters a density less than that of pure water. But these differences are so infinitesimal as to be easily accounted for by the gaseous matters which these waters contain. The actual differences from the density of pure water at 60°, afforded even by the most dense of the waters examined in this research, affect only the third place of decimals. Thus No. 11 has 87·811 parts of solid matter in a hundred thousand parts of water, or nearly one per centum, yet its gravity differs from pure recently boiled water distilled from glass by only $\frac{1}{0\cdot000\,1128}$. We should not look therefore for a very appreciable increase of gravity in a water containing only three parts of solid matter in a hundred thousand.

Table III shows the specific gravity.

Number of Water,	1	2	3	4	5	6
Specific Gravity,	1·000541	1·000060	1·0000894	1·000016	1·000118	0·999842
Number of Water,	7	8	9	10	11	
Specific Gravity,	1·000062	0·999924	1·000030	0·999967	0·001126	

The water No. 11 (from a well in Boston) proved to be highly saline. One standard quarter gallon of the water was boiled with the previous addition of a known quantity of pure anhydrous carbonate of soda, which threw down, during the progress of the ebullition, all the earths and other bases present, except the soda, converting them of course into carbonates. Then by the well known methods of analysis, the various ingredients were separately determined, and the soda quantitatively. I give subjoined the *actual* quantities obtained for one gallon of the water, without attempting to reconstruct the order of arrangement which we may suppose they had in nature. We found—

Chlorine,	11·8084
Sulphuric acid,	4·9683
Lime,	10·5853
Magnesia,	4·3922
Alumina and oxide of iron,	·9884
Phosphate of alumina,	3·8857
Silica,	6·1158
Carbonate of soda, equivalent of Nitric and crenic acids and loss,	7·3209
	50·0550

Both the silica and phosphate of alumina in the analysis of No. 11 were separately analyzed after their weight was recorded, to ascertain their entire purity and freedom from other matters. We also made a series of experiments to determine the action of these waters on metallic lead. The result of these trials was that every water, except No. 2, (Croton,) acted more or less on the lead. Those interested will find these results tabulated in the report before quoted.

In conclusion we may remark, that all natural waters may in a certain sense be properly called *mineral waters*, as they must each possess a specific and peculiar character dependent on the nature and amount of solid matters which they contain, and this must depend ultimately on the geological structure of the country where they are found. It is curious and instructive to see that even those waters which we consider the purest, contain, in a notable quantity, matters which are absolutely indispensable to satisfy the demands of the vegetable world, (and ultimately the animal also;) and when we remember the vast amount of evaporation from the expanded leaves of a full grown forest tree during a single summer day—can we any longer be at fault for a cause sufficient to account in the most satisfactory manner, for the various inorganic constituents of plants? It cannot be doubted that natural waters act a most important part in conveying into the upward current of organic life those inanimate elements, which, from their constant presence in plants, must be of primary importance, although we are at a loss to explain the mode of their action.*

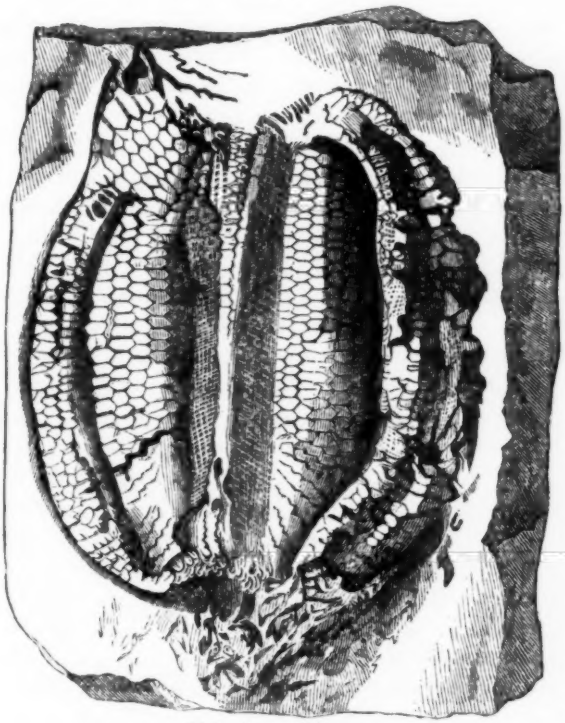
Yale College Laboratory, July 15, 1846.

* The foregoing analyses were made by authority of the city of Boston, preparatory to selecting one of the sources to supply that metropolis. Long Pond (Nos. 5 and 9) was finally chosen.

ART. XXIII.—*Description of a remarkable fossil Echinoderm, from the Limestone Formation of St. Louis, Missouri;* by J. G. NORWOOD, M. D., and D. D. OWEN, M. D.

IN the winter of 1844–5, during a visit to St. Louis, our search after organic remains in that vicinity, was rewarded by the discovery of a slab containing three specimens of a magnificent fossil belonging to the class Radiata, one of which is here represented.

Fig. 1.



Melonites multipora.

A minute inspection of the specimens, induces us to believe that they are gigantic Echinoderms, closely allied to the Echinideans; especially to the Echinus. It is true that in some parts of their anatomy, they differ from Goldfuss's description of that di-

vision of the order Echinodermata; yet, it is thought these aberrant characters are hardly sufficient to entitle them to be classed as a distinct group.

With the Echinideans or Echinides of Goldfuss, they agree in three essential characters, viz.: They are composed of ten fields (*areæ*); five broad (*areæ majores*), and five smaller (*areæ ambulacrorum*); and these are made up of little plates, disposed in rows. Pores or holes run in vertical rows up and down the small field (*area ambulacrorum*). There is, moreover, every evidence that the *os inferum* and the *anus* were central, as in the genus Echinus.

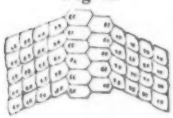
In the following, more trivial characters, they differ from Goldfuss's description of this group.

The plates of which the *areæ majores* consist, are mostly six- instead of five-angled, and are far more numerous than the elementary plates of which Goldfuss's genera are made up.

The plates of the *areæ majores* are arranged, not in single or double rows, but in many rows, varying from seven or eight at the widest part, to five or six at the top and bottom.

The plates constituting the *areæ ambulacrorum* are, doubtless, also more numerous, for, though rather obscurely marked, a close inspection shows that there are two kinds, viz., a double vertical row of elongated hexagonal plates, interlocking and connected laterally, on either side, with three rows of smaller, four-angled, irregularly rhomboidal plates, (very like the eschars on some species of Lepidodendron,) making in all, eight rows of plates, arranged as exhibited in fig. 2; while the corresponding *areæ* of Echinides, according to Goldfuss's description, are composed of but two rows. Each plate is perforated by two holes; so that each *ambulacrum* consists of eight double rows of pores.

Fig. 2.



No evidence of any kind has been obtained to show whether these bodies were pedunculated; but there is strong presumptive evidence that they were not. This is rendered probable, 1st, from their near approximation to the true Echinides; 2d, from their gigantic dimensions; 3d, because no stems have yet been found connected with any of the specimens; 4th, because pedunculated Echinoderms of such vast dimensions, would require a much larger stem than is exhibited by any portions of columns

hitherto discovered in this rock; 5th, all the Echinoderms at all approaching the size of this fossil are free bodies; 6th, the absence of a pelvis or circular rim for articulation to a stem; 7th, the presence of depressions in the position, and apparently for performing the offices of the *anus* and *os inferum*.

To sum up, then, with a connected description of the fossil, as far as the specimens in our possession will enable us to do so:—

Body ovoid or nearly spherical, free; *os inferum* central; *anus* central and above; *areæ* ten, five large (*areæ majores*), five small (*areæ ambulacrorum*); *plates* of the areæ majores mostly 6-sided, in many rows; those of the areæ ambulacrorum of two kinds—one set are elongated hexagons, disposed in double vertical rows in the centre of the area, which is elevated into a prominent ridge, along the summit of which the interlocking serrated suture of this double row is situated; the other set smaller, irregularly rhomboidal, and running in oblique rows on either side of the former. Each plate of the areæ ambulacrorum is pierced by two holes; these are central in the rhomboidal plates, but in the hexagonal plates, are situated near the angle furthest from the before mentioned central suture. Each ambulacrum is thus constituted of eight alternating double rows of pores.

Fig. 3.

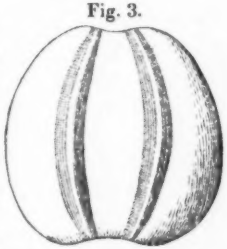


Figure 3, is an outline of a restored representation of the fossil reduced. We propose as an appropriate name for it, *Melonites multipora*, on account of its resemblance, in general outline, to some species of melon, and the great number of pores in the ambulacrum.

This fossil is known amongst the quarrymen, as the "*coltsfoot*." By reference to fig. 1, it will be seen that it bears considerable resemblance to the impress of the frog of a horse's foot. This is worthy of note, since it confirms, in a most remarkable manner, an assertion made in a former number of this Journal, (1st Ser. vol. xliii, No. 1, p. 17,) that those unacquainted with the science of geology, frequently mistake for fossil *footprints*, what are, in fact, moulds of shells, or merely casual appearances. It also warns the geologist how cautious he should be in investigating reported footmarks in solid rock.

The discovery of this fossil is peculiarly interesting, not only on account of its gigantic dimensions, measuring, as it lies on the

slab, five and a half inches in vertical diameter, and four and two-tenths in transverse diameter, but, also, as affording additional evidence of the existence of this group of radiated animals at very remote periods.

All the specimens,* hitherto found, were obtained near low water at St. Louis, from a limestone formation, considered the equivalent of the mountain limestone of Europe, associated with the *Producta* figured in vol. xliii, No. 1, p. 81, 1st Ser., of this Journal, an Aulopora, ? *Gorgonia*, *Retepora*, *Ceriopora*, ? and a small *Delthyris*.† It is situated, by estimate, from fifty to seventy-five feet below the lowest seam of coal at present known in the great Illinois coal field.

Madison, Ia., June 20, 1846.

ART. XXIV.—*Observations on the Fossil Plants, of the Coal Field of Tuscaloosa, Alabama;* by C. LYELL, Esq., with a description of some species by C. T. F. BUNBURY, Esq., F. G. S.

IN a former number of the American Journal,‡ I described the geographical position of the coal fields of Alabama, and stated that the carboniferous strata of the Warrior river extend southwards to the town of Tuscaloosa in the neighborhood of which, aided by Professor Brumby, (who had already made some progress in the investigation,) I succeeded in collecting impressions of Sigillaria, Stigmaria, Lepidodendron, Calamites, Neuropteris and several other ferns. I also stated that I recognized a specific identity between several of these fossils, and some of the most abundant coal plants of Pennsylvania and Europe. On my return to England in June, 1846, I submitted the specimens to my friend C. T. F. Bunbury, who immediately compared them with the best published plates and descriptions, and with European fossils in the cabinets of the Geological Society of London. The result of his examination has fully confirmed the conclusion to

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* The first specimens of this fossil were found by H. A. Prout, M. D., of St. Louis, sometime previous to our discovery. Most of the specimens yet obtained, are compressed; but Dr. P. has one in his cabinet which is detached, and in the original spheroidal form.

† For want of the necessary works of reference, we are unable, at present, to decide whether these genera, belong to undescribed species.

‡ Second Series, i, 371.

which I had arrived, and it will be seen in the sequel that notwithstanding the loss of several ferns and Sigillariæ which were obtained in a disintegrating matrix near the outcrop of the strata, where the shales are changed into soft, pale, laminated clay, this botanist has been able to detect no less than sixteen forms, of which the following is an enumeration.—1. Sphenopteris latifolia, *Ad. Brongn.* 2. S. Dubuissoni? *Ad. Brongn.* 3. Sphenopteris, allied to the last, perhaps a variety of the same. 4. Neuropteris tenuifolia, *Ad. Brongn.* 5. Neuropteris Grangeri, or N. gigantea? 6. Calamites cannæformis. 7. Calamites, obscure specimen allied to the foregoing. 8. Lepidodendron elegans. 9. Lepidodendron allied to L. dilatatum, *Foss. Flora.* 10. Lepidophyllum? 11. Sigillaria, decorticated. 12. Stigmaria ficoides. 13. Poacites? 14. Bechera tenuis, n. sp., very nearly allied to B. grandis, *Foss. Flora.* 15. Asterophyllites? flaccida. 16. Phyllites, resembling the leaf of Sparganium or Eriocaulon.

The Palæontologist will perceive at once that no less than half of the specimens in the above list, agree with well-known European fossils of the old carboniferous formation, and the rest belong to genera which are common in our coal measures, and may perhaps agree with European fossils when procured in a better state of preservation. The leaves however resembling Sparganium, or still more closely some of the Junci such as Eriocaulon, and which are very abundant, appear to Mr. Bunbury to be new, (see fig. p. 232.)

The three species of Sphenopteris mentioned in the above list all differ from any ferns which I met with in my travels in North America in 1841-2, but one of them S. latifolia is a common Northumberland species found at Newcastle. Neuropteris tenuifolia is also met with at Newcastle, and N. Grangeri occurs in Staffordshire, as also at Zanesville, Ohio. Calamites cannæformis is one of the most abundant forms both in Europe, the United States, and Nova Scotia, and the same may be said of Lepidodendron elegans, the Alabama variety being that commonly met with at Sidney, Cape Breton. Lepidodendron dilatatum is a Northumberland fossil. Lepidopyllum, probably the leaves of the preceding genus, is also a form frequently met with in the British and other European coal strata. The same is true of Stigmaria ficoides, and the genera Stigmaria and Sigillaria are as yet exclusively

characteristic of the carboniferous group. Lastly, Bechera tenuis has been found in Coalbrook Dale, Shropshire.

When we recollect that the Tuscaloosa coal field is situated in lat. 33° 10′ North, and that so many of the species now first examined agree with fossils occurring more than twenty degrees farther north in the British Isles, and at a distance of five thousand miles, with a broad ocean intervening, we cannot but be struck with this wide diffusion of a Flora, so singularly uniform in its character. The phenomena seem to imply at the remote period in question the existence, first, of continuous land across the space now occupied by the Atlantic, or at least of a chain of islands in that region; and secondly, a remarkably equable climate; for Dr. Hooker, author of "the Antarctic Flora," has lately observed that no existing Flora, viewed as a whole, preserves so uniform a character for so great a distance in a north and south direction, as that extending from the south of the island of Chiloe to Cape Horn, a range of twelve or thirteen degrees of latitude. This wide distribution occurs where the climate in winter and summer, and throughout the whole year, is peculiarly equable.

Alabama is the most southern spot in the northern hemisphere where the ancient carboniferous flora has yet been studied; geologists therefore will rejoice to hear that Prof. Brumby is fully alive to the importance of a more full investigation of the plants of that country, of which he will soon, it is hoped, have it in his power to form a considerable collection.

Description of Alabama Coal Plants; by C. T. F. Bunbury, Esq.

1. Sphenopteris latifolia. *Ad. Brongn.* Veg. Foss., p. 205, t. 57, f. 1—3. (*Not* of Lindley and Hutton.)

One of these Alabama specimens approaches to S. acutifolia, *Brongn.*, which is probably not distinct from S. latifolia.

2. Sphenopteris Dubuissoni? *Ad. Brongn.* Veg. Foss., p. 195, t. 54, f. 4?

Agrees so nearly with Brongniart's description and figure that I can hardly suppose it to be a different species; the only distinction I perceive, is, that in our plant both the main rachis and that of the primary pinnæ is beset with numerous small protuberances,

(forming pits in the impression,) indicating the insertion of hairs or scales, which are not noticed by Brongniart. That author's specimens of S. Dubuissoni were obtained from the coal mines of Montrelais, Loire-Inferieure.

3. Sphenopteris.

Perhaps a variety of the last, or a different stage of growth. The secondary pinnæ however are much longer, the pinnules more distant and more deeply divided, with narrower and more diverging segments.

4. Neuropteris tenuifolia. *Ad. Brongn.*, p. 241, t. 72, f. 3.

5. Neuropteris gigantea? or N. Grangeri?

One or two detached leaflets, scarcely determinable with certainty.

6. Calamites cannæformis. *Ad. Brongn.*, p. 131, t. 21.

7. Calamites.

An obscure specimen, with narrower and more prominent ridges than the foregoing, and no distinct tubercles.

8. Lepidodendron elegans.

The Alabama plant has narrower and more elongated areolæ than the British specimens I have seen of L. elegans, but agrees exactly with specimens from Cape Breton.

9. Lepidodendron.

Decorticated, and very obscure; evidently a large species, with broad rhomboidal areolæ, like L. dilatatum, *Foss. Fl.*

10. Lepidodendron?

Probably the leaves of a Lepidodendron or some nearly allied plant, and much resembling those of L. acerosum, *Foss. Fl.*, t. 8. They are two inches or more in length, narrow, linear, straight, flat, (probably owing to compression,) and marked with a distinct but somewhat irregular ridge or keel along the middle.

11. Sigillaria.

Decorticated and indeterminable.

12. Stigmaria ficoides?

This is doubtless one of the forms which have been commonly comprehended under the name of Stigmaria ficoides; but it is not quite clear that it is either the Stigmaria ficoides or S. Anabathra of Corda. The scars do not exhibit the distinctly umbilicated socket-like appearance observable in the best characterized specimens of these fossils; they appear as if the leaves (or rootlets) had been abruptly broken off, rather than dis-articulated. I

have elsewhere noticed the same peculiarity in specimens of Stigmaria from Nova Scotia.

13. Poacites?

Fragments of a broad leaf, rounded at the base, without a midrib, with very numerous, fine, close, apparently simple veins, which diverge at first in a curving manner from the base of the leaf, and then become parallel. No stalk visible.

14. Bechera tenuis (n. sp.?)

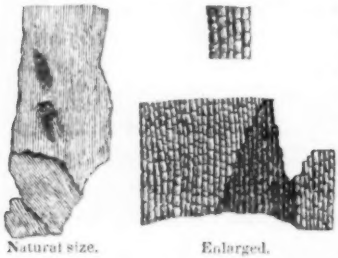
This has so close a resemblance to the Bechera grandis, *Lindl. and Hutt. Foss. Fl.*, t. 173, that I am not quite confident of the propriety of considering it a distinct species. It is however a much smaller and more delicate plant, and of a more lax and diffuse habit. I think it safer for the present to treat it as another species, especially since it comes from a locality so very remote. Lindley and Hutton's plant was from Coalbrook Dale.

15. Asterophyllites? flaccida.

Fragments, very numerous, but in so unsatisfactory a state as hardly to admit of description. It was probably an aquatic plant, of a very tender and flaccid consistence, with small, verticillate, linear, bluntish leaves, which appear to have no distinct midrib, but several faint longitudinal striæ or veins. In this last peculiarity it departs from the character of Asterophyllites, and it may not be really allied to any of the plants hitherto comprehended under that vague name. It is possible that the apparent leaves may in reality be short branches, and that the plant may have had some affinity to Chara.

16. Phyllites?

In many of the Tuscaloosa specimens there occur, very plentifully, thin layers of vegetable matter, possessing a very remarkable and delicate structure, but without any definite outline that I can discover, so that I remain uncertain whether they are portions of leaves or of flattened stems. Their surface appears, under an ordinary pocket magnifier, most delicately and regularly crossbarred, with strong longitudinal lines and short transverse bars, producing the appearance of a fine net-work, with nearly rectangular meshes, (see the figure.)



Natural size. Enlarged.

The longitudinal lines or veins, though in general nearly parallel, are by no means accurately so, but are wavy in direction, approximating to one another at uncertain intervals, and occasionally even becoming confluent. This structure somewhat resembles that of the leaves of Sparganium natans, but is far more minute and delicate. It approaches still more closely in texture to the leaves of some species of Eriocaulon.

London, June 30, 1846.

ART. XXV.—*Generality of Magnetic and Diamagnetic Action;* by M. FARADAY, Phil. Trans., part i, for 1846, p. 52.

IN the last Volume of this Journal, p. 421–425, we gave an abstract of Dr. Faraday's recent researches on magnetic actions. If our limits would permit, we should wish to publish the whole memoir, but must content ourselves with giving the general conclusions with which the distinguished author closes his remarkable researches.—EDS.

2417.* Such are the facts which, in addition to those presented by the phenomena of light, establish a magnetic action or condition of matter new to our knowledge. Under this action, an elongated portion of such matter usually places itself at right angles to the lines of magnetic force; this result may be resolved into the simpler one of repulsion of the matter by either magnetic pole. The set of the elongated portion, or the repulsion of the whole mass, continues as long as the magnetic force is sustained, and ceases with its cessation.

2418. By the exertion of this new condition of force, the body moved may pass either *along* the magnetic lines or *across* them; and it may move along or across them in either or any direction. So that two portions of matter simultaneously subject to this power, may be made to approach each other as if they were mutually attracted, or recede as if mutually repelled. All the phenomena resolve themselves into this, that a portion of such matter, when under magnetic action, tends to move from stronger to weaker places or points of force. When the substance is surrounded by lines of magnetic force of equal power on all sides,

* The numbers are those of Dr. Faraday's Experimental Researches.

it does not tend to move, and is then in marked contradistinction with a linear current of electricity under the same circumstances.

2419. This condition and effect is new, not *only* as it respects the exertion of power by a magnet over bodies previously supposed to be indifferent to its influence, but is *new* as a magnetic action, presenting us with a second mode in which the magnetic power can exert its influence. These two modes are in the same general antithetical relation to each other as positive and negative in electricity, or as northness and southness in polarity, or as the lines of electric and magnetic force in magneto-electricity; and the diamagnetic phenomena are the more important, because they extend largely, and in a new direction, that character of duality which the magnetic force already, in a certain degree, was known to possess.

2420. All matter appears to be subject to the magnetic force as universally as it is to the gravitating, the electric, and the chemical or cohesive forces; for that which is not effected by it in the manner of ordinary magnetic action, is effected in the manner I have now described; the matter possessing for the time the solid or fluid state. Hence substances appear to arrange themselves into two great divisions, the magnetic, and that which I have called the diamagnetic classes; and between these classes the contrast is so great and direct, though varying in degree, that where a substance from the one class will be attracted, a body from the other will be repelled; and where a bar of the one will assume a certain position, a bar of the other will acquire a position at right angles to it.

2421. As yet I have not found a single solid or fluid body, not being a mixture, that is perfectly neutral in relation to the two lists; *i. e.* that is neither attracted nor repelled in air. It would probably be important to the consideration of magnetic action, to know if there were any natural simple substance possessing this condition in the solid or fluid state. Of compound or mixed bodies there may be many; and as it may be important to the advancement of experimental investigation, I will describe the principles on which such a substance was prepared when required for use as a circumambient medium.

2422. It is manifest that the properties of magnetic and diamagnetic bodies are in opposition as respects their dynamic effects; and, therefore, that by a due mixture of bodies from each

class, a substance having any intermediate degree of the property of either may be obtained. Protosulphate of iron belongs to the magnetic, and water to the diamagnetic class; and using these substances, I found it easy to make a solution which was neither attracted nor repelled, nor pointed when in air. Such a solution pointed axially when surrounded by water. If made somewhat weaker in respect of the iron, it would point axially in water but equatorially in air; and it could be made to pass more and more into the magnetic or the diamagnetic class by the addition of more sulphate of iron or more water.

2423. Thus a *fluid* medium was obtained, which, practically, as far as I could perceive, had every magnetic character and effect of a gas, and even of a vacuum; and as we possess both magnetic and diamagnetic glass, it is evidently possible to prepare a *solid* substance possessing the same neutral magnetic character.

2424. The endeavor to form a general list of substances in the present imperfect state of our knowledge would be very premature: the one below is given therefore only for the purpose of conveying an idea of the singular association under which bodies come in relation to magnetic force, and for the purpose of general reference hereafter:—*Iron, nickel, cobalt, manganese, palladium, crown-glass, platinum, osmium*—0° *air and vacuum, arsenic, ether, alcohol, gold, water, mercury, flint-glass, tin, heavy-glass, antimony, phosphorus, bismuth.*

2425. It is very interesting to observe that metals are the substances which stand at the extremities of the list, being of all bodies those which are most powerfully opposed to each other in their magnetic condition. It is also a very remarkable circumstance that these differences and departures from the medium condition, are in the metals of the two extremes, iron and bismuth, associated with a small conducting power for electricity. At the same time the *contrast* between these metals, as to their fibrous and granular state, their malleable and brittle character, will press upon the mind whilst contemplating the possible condition of their molecules when subjected to magnetic force.

2426. In reference to the metals, as well as the diamagnetics not of that class, it is satisfactory to have such an answer to the opinion that all bodies are magnetic as iron, as does not consist in a mere negation of that which is affirmed, but in proofs that they are in a different and opposed state, and are able to counteract a very considerable degree of magnetic force (2448).

2427. As already stated, the magnetic force is so strikingly distinct in its action upon bodies of the magnetic and the diamagnetic class, that when it causes the attraction of the one it produces the repulsion of the other; and this we cannot help referring, in some way, to an action upon the molecules or the mass of the substances acted upon, by which they are thrown into different conditions and affected accordingly. In that point of view it is very striking to compare the results with those which are presented to us by a polarized ray, especially as then a remarkable difference comes into view; for if transparent bodies be taken from the two classes, as for instance, heavy glass or water from the diamagnetic, and a piece of green glass or a solution of green vitriol from the magnetic class, then a given line of magnetic force will cause the repulsion of one and the attraction of the other; but this same line of force which thus affects the particles so differently, affects the polarized ray when passing through them precisely in the *same* manner in both cases; for the two bodies cause its rotation in the *same* direction.

2428. This consideration becomes even more important when we connect it with the diamagnetic and the optical properties of bodies which rotate a polarized ray. Thus the iron solution and a piece of quartz, having the power to rotate a ray, point by the influence of the *same* line of magnetic force, the one axially and the other equatorially; but the rotation which is impressed on a ray of light by these two bodies, as far as they are under the influence of the same magnetic force, is the *same* for both. Further, this rotation is quite independent of, and quite unlike that of the quartz in a most important point; for the quartz by itself can only rotate the ray in one direction, but under the influence of the magnetic force it can rotate it both to the right and left, according to the course of the ray. Or, if two pieces of quartz (or two tubes of oil of turpentine) be taken which can rotate the ray *different* ways, the further rotative force manifested by them when under the dominion of the magnetism is always the *same* way; and the direction of that way may be made either to the right or left in either crystal of quartz. All this time the *contrast* between the quartz as a diamagnitic, and the solution of iron as a magnetic body remains undisturbed. Certain considerations regarding the character of a ray, arising from these contrasts, press strongly on my mind, which, when I have had time

to submit them to further experiment, I hope to present to the Society.

2429. Theoretically, an explanation of the movements of the diamagnetic bodies, and all the dynamic phenomena consequent upon the action of magnets on them, might be offered in the supposition that magnetic induction caused in them a contrary state to that which it produced in magnetic matter; *i. e.* that if a particle of each kind of matter were placed in a magnetic field both would become magnetic, and each would have its axis parallel to the resultant of magnetic force passing through it; but the particle of magnetic matter would have its north and south poles opposite, or facing towards the contrary poles of the inducing magnet, whereas with the diamagnetic particles the reverse would be the case; and hence would result approximation in the one substance, recession in the other.

2430. Upon Ampère's theory, this view would be equivalent to the supposition, that as currents are induced in iron and magnetics parallel to those existing in the inducing magnet or battery wire; so in bismuth, heavy glass, and diamagnetic bodies, the currents induced are in the contrary direction. This would make the currents in diamagnetics the same in direction as those which are induced in diamagnetic conductors at the *commencement* of the inducing current; and those in magnetic bodies the same as those produced at the *cessation* of the same inducing current. No difficulty would occur as respects non-conducting magnetic and diamagnetic substances, because the hypothetical currents are supposed to exist not in the mass, but round the particles of the matter.

2431. As far as experiment yet bears upon such a notion, we may observe, that the known inductive effects upon masses of magnetic and diamagnetic metals *are the same*. If a straight rod of iron be carried across magnetic lines of force, or if it, or a helix of iron rods or wire, be held near a magnet, as the power in it rises electric currents are induced, which move through the bars or helix in certain determinate directions. If a bar or a helix of bismuth be employed under the same circumstances, the currents are again induced, and precisely in the same direction as in the iron, so that here no difference occurs in the direction of the induced current, and not very much in its force, nothing like so much indeed as between the current induced in either of these

metals and a metal taken from near the neutral point. Still there is this difference remaining between the conditions of the experiment and the hypothetical case; that in the former the induction is manifested by currents in the masses, whilst in the latter, *i. e.* in the special magnetic and diamagnetic effects, the currents, if they exist, are probably about the particles of the matter.

2432. The magnetic relation of aëriform bodies is exceedingly remarkable. That oxygen or nitrogen gas should stand in a position intermediate between the magnetic and diamagnetic classes; that it should occupy the place which *no* solid or liquid element can take; that it should show no change in its relations by rarefaction to any possible degree, or even when the space it occupies passes into a vacuum; that it should be the same magnetically with any other gas or vapor; that it should not take its place at one end but in the very middle of the great series of bodies; and that all gases or vapors should be alike, from the rarest state of hydrogen to the densest state of carbonic acid, sulphurous acid, or ether vapor, are points so striking as to persuade one at once that air must have a great and perhaps an active part to play in the physical and terrestrial arrangement of magnetic forces.

2433. At one time I looked to air and gases as the bodies which, allowing attenuation of their substance without addition, would permit of the observation of corresponding variations in their magnetic properties; but now all such power by rarefaction appears to be taken away; and though it is easy to prepare a liquid medium which shall act with other bodies as air does (2422), still it is not truly in the same relation to them; neither does it allow of dilution, for to add water or any such substance is to add to the diamagnetic power of the liquid; and, if it were possible to convert it into vapor and so dilute it by heat, it would pass into the class of gases and be magnetically undistinguishable from the rest.

2434. It is also very remarkable to observe the apparent disappearance of magnetic condition and effect when bodies assume the vaporous or gaseous state, comparing it at the same time with the similar relation to light; for as yet no gas or vapor has been made to show any magnetic influence over the polarized ray, even by the use of powers far more than enough to manifest such action freely in liquid and solid bodies.

2435. Whether the negative results obtained by the use of gases and vapors depend upon the smaller quantity of matter in a given volume, or whether they are direct consequences of the altered physical condition of the substance, is a point of very great importance to the theory of magnetism. I have imagined, in elucidation of the subject, an experiment with one of M. Cagniard de la Tour's ether tubes, but expect to find great difficulty in carrying it into execution, chiefly on account of the strength, and therefore the mass of the tube necessary to resist the expansion of the imprisoned heated ether.

2436. The remarkable condition of air and its relation to bodies taken from the magnetic and diamagnetic classes, causes it to point equatorially in the former and axially in the latter. Or, if the experiment presents its results under the form of attraction and repulsion, the air moves as if repelled in a magnetic medium and attracted in a medium from the diamagnetic class. Hence it seems as if the air were magnetic when compared with diamagnetic bodies, and of the latter class when compared to magnetic bodies.

2437. This result I have considered as explained by the assumption that bismuth and its congeners are absolutely repelled by the magnetic poles, and would, if there were nothing else concerned in the phenomena than the magnet and the bismuth, be equally repelled. So also with the iron and its similars, the attraction has been assumed as a direct result of the mutual action of them and the magnets; further, these actions have been admitted as sufficient to account for the pointing of the air both axially and equatorially, as also for its apparent attraction and repulsion; the effect in these cases being considered as due to the travelling of the air to those positions which the magnetic or diamagnetic bodies tended to leave.

2438. The effects with air are, however, in these results precisely the same as those which were obtained with the solutions of iron of various strength, where *all* the bodies belonged to the magnetic class, and where the effect was evidently due to the greater or smaller degree of magnetic power possessed by the solutions. A weak solution in a stronger pointed equatorially and was repelled like a diamagnetic, not because it did not tend by attraction to an axial position, but because it tended to that position with less force than the matter around it; so the question

will enter the mind, whether the diamagnetics, when in air, are repelled and tend to the equatorial position for any other reason, than that the air is more magnetic than they are, and tends to occupy the axial space. It is easy to perceive that if all bodies were magnetic in different degrees, forming one great series from end to end, with air in the middle of the series, the effects would take place as they do actually occur. Any body from the middle part of the series would point equatorially in the bodies above it and axially in those beneath it; for the matter which, like bismuth, goes from a strong to a weak point of action, may do so only because that substance, which is already at the place of weak action, tends to come to the place where the action is strong; just as in electrical induction the bodies best fitted to carry on the force are drawn into the shortest line of action. And so air in water, or even under mercury, is, or appears to be, drawn towards the magnetic pole.

2439. But if this were the true view, and air had such power amongst other bodies as to stand in the midst of them, then one would be led to expect that rarefaction of the air would affect its place, rendering it, perhaps, more diamagnetic, or at all events altering its situation in the list. If such were the case, bodies that set equatorially in it in one state of density, would, as it varied, change their position, and at last set axially: but this they do not do; and whether the rarefied air be compared with the magnetic or the diamagnetic class, or even with dense air, it keeps its place.

2440. Such a view also would make mere space magnetic, and precisely to the same degree as air and gases. Now though it may very well be, that space, air and gases, have the same general relation to magnetic force, it seems to me a great additional assumption to suppose that they are all absolutely magnetic, and in the midst of a series of bodies, rather than to suppose that they are in a normal or zero state. For the present, therefore, I incline to the former view, and consequently to the opinion that diamagnetics have a specific action, antithetically distinct from ordinary magnetic action, and have thus presented us with a magnetic property new to our knowledge.

2441. The amount of this power in diamagnetic substances seems to be very small, when estimated by its dynamic effect, but the motion which it can generate is perhaps not the most

striking measure of its force; and it is probable that when its nature is more intimately known to us, other effects produced by it and other indicators and measurers of its powers, than those so imperfectly made known in this paper, will come to our knowledge; and perhaps even new classes of phenomena will serve to make it manifest and indicate its operation. It is very striking to observe the feeble condition of a helix when alone, and the astonishing force which, in giving and receiving, it manifests by association with a piece of soft iron. So also here we may hope for some analogous development of this element of power, so new as yet to our experience. It cannot for a moment be supposed, that, being given to natural bodies, it is either superfluous or insufficient, or unnecessary. It doubtless has its appointed office, and that, one which relates to the whole mass of the globe; and it is probably because of its relation to the whole earth, that its amount is necessarily so small (so to speak) in the portions of matter which we handle and subject to experiment. And small as it is, how vastly greater is this force, even in dynamic results, than the mighty power of gravitation, for instance, which binds the whole universe together, when manifested by masses of matter of equal magnitude!

2442. With a full conviction that the uses of this power in nature will be developed hereafter, and that they will prove, as all other natural results of force do, not merely important but essential, I will venture a few hasty observations.

2443. Matter cannot thus be affected by the magnetic forces without being itself concerned in the phenomenon, and exerting in turn a due amount of influence upon the magnetic force. It requires mere observation to be satisfied that when a magnet is acting upon a piece of soft iron, the iron itself, by the condition which its particles assume, carries on the force to distant points, giving it direction and concentration in a manner most striking. So also here the condition which the particles of intervening diamagnetics acquire, may be the very condition which carries on and causes the transfer of force through them. In former papers* I proposed a theory of electrical induction founded on the action of contiguous particles, with which I am now even more content than at the time of its proposition: and I then ventured

* Philosophical Transactions, 1838, Part I.

to suggest that probably the lateral action of electrical currents which is equivalent to electrodynamic or *magnetic* action, was also conveyed onwards in a similar manner. At that time I could discover no peculiar condition of the intervening or diamagnetic matter; but now that we are able to distinguish such an action, so *like* in its nature in bodies so *unlike* in theirs, and by that so like in character to the manner in which the magnetic force pervades all kinds of bodies, being at the same time as universal in its presence as it is in its action; now that diamagnetics are shown not to be indifferent bodies, I feel still more confidence in repeating the same suggestion, and asking whether it may not be by the action of the contiguous or next succeeding particles that the magnetic force is carried onwards, and whether the peculiar condition acquired by diamagnetics when subject to magnetic action, is not that condition by which such propagation of the force is affected?

2444. Whichever view we take of solid and liquid substances, whether as forming two lists, or one great magnetic class (2424, 2437), it will not, as far as I can perceive, affect the question. They are all subject to the influence of the magnetic lines of force passing through them, and the virtual difference in property and character between any two substances taken from different places in the list (2424,) will be the same; for it is the differential relation of the two which governs their mutual effects.

2445. It is that group which includes air, gases, vapours, and even a vacuum which presents any difficulty to the mind; but here there is such a wonderful change in the physical constitution of the bodies, and such high powers in some respects are retained by them, whilst others seem to vanish, that we might almost expect some peculiar condition to be assumed in regard to a power so universal as the magnetic force. Electric induction being an action through distance, is varied enough amongst solid and liquid bodies; but, when it comes to be exerted in air or gases, where it most manifestly exists, it is alike in amount in all; neither does it vary in degree in air however rare or dense it may be. Now magnetic action may be considered as a mere function of electric force, and if it should be found to correspond with the latter in this particular relation to air, gases, &c., it would not excite in my mind any surprise.

2446. In reference to the manner in which it is possible for electric force, either static or dynamic, to be transferred from particle to particle when they are at a distance from each other, or across a vacuum, I have nothing to add to what I have said before. The supposition that such can take place, can present nothing startling to the mind of those who have endeavored to comprehend the radiation and the conduction of heat under one principle of action.

2447. When we consider the magnetic condition of the earth as a whole, without reference to its possible relation to the sun, and reflect upon the enormous amount of diamagnetic matters which, to our knowledge, forms its crust; and when we remember that magnetic curves of a certain amount of force and universal in their presence, are passing through these matters and keeping them constantly in that state of tension, and therefore of action, which I hope successfully to have developed, we cannot doubt but that some great purpose of utility to the system, and to us its inhabitants, is thereby fulfilled, which now we shall have the pleasure of searching out.

2448. Of the substances which compose the crust of the earth, by far the greater portion belongs to the diamagnetic class; and though ferruginous and other magnetic matters, being more energetic in their action, are consequently more striking in their phenomena, we should be hasty in assuming that therefore they overrule entirely the effect of the former bodies. As regards the ocean, lakes, rivers, and the atmosphere, they will exert their peculiar effect almost uninfluenced by any magnetic matter in them; and as respects the rocks and mountains, their diamagnetic influence is perhaps greater than might be anticipated. I mentioned that, by adjusting water and a salt of iron together, I obtained a solution inactive in air (2422); that is, by a due association of the forces of a body from each class, water and a salt of iron, the magnetic force of the latter was entirely counteracted by the diamagnetic force of the former, and the mixture was neither attracted nor repelled. To produce this effect, it required that more than 48·6 grains of crystallized protosulphate of iron should be added to ten cubic inches of water (for these proportions gave a solution which still set equatorially), a quantity so large, that I was greatly astonished on observing the power of the water to overcome it. It is not therefore at all unlikely that many of the

masses which form the crust of this our globe may have an excess of diamagnetic power and act accordingly.

2449. Though the general disposition of the magnetic curves which permeate and surround our globe resemble those of a very short magnet, and therefore give lines of force rapidly diverging in their general form, yet the magnitude of the system prevents us from observing any diminution of their power within small limits; so that probably any attempt on the surface of the earth to observe the tendency of matter to pass from stronger to weaker places of action would fail. Theoretically, however, and at first sight, I think a pound of bismuth or of water, estimated at the equator, where the magnetic needle does not dip, ought to weigh less when taken into latitudes where the dip is considerable; whilst a pound of iron, nickel, or cobalt, ought, under the same change of circumstances, to weigh more. If such should really prove to be the case, then a ball of iron and another of bismuth, attached to the ends of a delicate balance beam, should cause that beam to take different inclinations on different parts of the surface of the earth; and it does not seem quite impossible that an instrument to measure one of the conditions of terrestrial magnetic force might be constructed on such a principle.

2450. If one might speculate upon the effect of the whole system of curves upon very large masses, and these masses were in plates or rings, then they would, according to analogy with the magnetic field, place themselves equatorially. If Saturn were a magnet as the earth is, and his ring composed of diamagnetic substances, the tendency of the magnetic forces would be to place it in the position which it actually has.

2451. It is a curious sight to see a piece of wood, or of beef, or an apple, or a bottle of water repelled by a magnet, or taking the leaf of a tree and hanging it up between the poles, to observe it take an equatorial position. Whether any similar effects occur in nature among the myriads of forms which, upon all parts of its surface, are surrounded by air, and are subject to the action of lines of magnetic force, is a question which can only be answered by future observation.

2452. Of the interior of the earth we know nothing, but there are many reasons for believing that it is of a high temperature. On this supposition I have recently remarked, that at a certain distance from the surface downwards, magnetic substances must

be entirely destitute, either of the power of retaining magnetism, or becoming magnetic by induction from currents in the crust or otherwise.* This is evidently an error; that the iron, &c. can retain no magnetic condition of itself, is very probably true, but that the magnetic metals and all their compounds retain a certain degree of power to become magnetic by induction, whatever their temperature, has now been proved. The deep magnetic contents of the earth, therefore, though they probably do not constitute of themselves a central magnet, are just in the condition to act as a very soft iron core to the currents around them, or other inducing actions, and very likely are highly important in this respect. What the effect of the diamagnetic part may be under the influence of such inductive forces, we are not prepared to state; but as far as I have been able to observe, such bodies have not their power diminished by heat.

2453. If the sun have anything to do with the magnetism of the globe, then it is probable that part of its effect is due to the action of the light that comes to us from it; and in that expectation the air seems most strikingly placed round our sphere, investing it with a transparent diamagnetic, which therefore is permeable to his rays, and at the same time moving with great velocity across them. Such conditions seem to suggest the possibility of magnetism being there generated; but I shall do better to refrain from giving expression to these vague thoughts (though they will press in upon the mind), and first submitting them to rigid investigation by experiment, if they prove worthy, then present them hereafter to the Royal Society.

ART. XXVI.—*Caricography;* by Prof. C. DEWEY, M. D. and D. D.

(Appendix, continued from Vol. xlix, First Series, p. 48.)

No. 199. *C. flaccosperma*, Dew.

Spicis distinctis; staminifera unica cylindracea, squamam oblongam obtusam ferente; pistilliferis 3–6 *tristigmaticis*, oblongis cylindraceis, sublaxifloris, bracteatis, superiore subsessile, inferioribus exserte pedunculatis, suberectis, subremotis; fructibus ovatis, oblongis, subobtusis, minute nervosis, lævibus, subinflatis, ore inte-

* Philosophical Magazine, 1845, vol. xxvii, p. 3.

gro vel emarginato, squamam ovatam acutam duplo vel triplo longioribus; culmis pedalibus glaucis.

Culm a foot high, smooth, leafy towards the base; leaves lanceolate, 3 to 4 lines broad, glaucous, smooth, shorter below; staminate spike short cylindric with an oblong and obtuse scale; pistillate spikes 3 to 6 with *three* stigmas, long and cylindric, suberect and loose-flowered, the lower ones exsertly pedunculate with long leafy bracts and shortish sheaths; fruit oblong-ovate, obtuse or emarginate, slightly nerved, a little inflated; pistillate scale ovate acute and about one-third as long as the fruit; culm and leaves smooth and glaucous.

Florida and Louisiana, Dr. Leavenworth; has a remote resemblance to *C. granularis*, Muh.

No. 200. *C. Leavenworthii*, Dew.

Spiculis ovatis aggregatis 3–5, superne staminiferis sessilibus, sqamo-bracteatis; fructibus ovatis, compressis, superne convexis, acutis, brevirostratis, distigmaticis, ore integris, brevibus, glabris, squama ovato-acuta vix duplo longioribus; culmis tenuibus basi foliaceis.

Culm 6–12 inches high, erect, slender, triquetrous, leafy below the middle; leaves linear, narrow and slender, flat, often longer than the culm, shorter towards the root; spikelets aggregated into a head, staminate above; staminate scales lanceolate; fruit short-ovate, convex above, short-rostrate, smooth, with an ovate and acute scale shorter than the fruit; under the spikelets is a bract or ovate scale passing into a long cusp or awn.

Louisiana, Dr. Leavenworth. From the kindred species, as *C. rosea*, *C. retroflexa*, *C. disperma*, it is readily distinguishable. It closely resembles Tab. Ee, fig. 91, Schk., and called by him a variety of *C. muricata;* but from this our plant is separated far by its fruit and scale.

No. 201. *C. Crawei*, Dew.

Spicis staminiferis 1–3, sæpius unica, oblongis cylindraceis, superiore multo longiore et rarissima apicem fructifera, cum squamis oblongis densis brevi-acutis; pistilliferis 3–6 oblongo-cylindraceis, *tristigmaticis*, subsessilibus vel exserte pedunculatis, densifloris, remotis, vel subaggregatis, infima subradicali et longo-pedunculata; fructibus ovatis teretibus vel conicis, subtriquetris, trinervosis, glabris, vix rostratis, ore integris, squama ovata obtusa vel subacuta duplo longioribus.

Culm 4–10 inches high, triquetrous, oblique, stiff, leafy at the base; bracts sheathing, leafy and long, striate; staminate one, oblong, cylindric, often with one or two more, at or near the base and much shorter, the highest is very rarely pistillate at the summit, and the scales are oblong, obtusish, close, tawny; pistillate spikes 3–6, oblong, cylindric, nearly an inch long or more, densely flowered, erect, remote or near, highest nearly sessile, the middle exsertly pedunculate, the lowest subradical and often very long pedunculate; fruit ovate, conic, subtriquetrous, glabrous, very slightly rostrate, orifice entire; scales of the fruit ovate, obtuse, sometimes acutish, half as long as the fruit; plant pale green, and glabrous; leaves linear, flat, striate, often very short, sometimes half length of culm.

Found at Watertown, and Griffin's Bay, Jefferson Co., N. Y.—Dr. Crawe, whose name it bears. It is too remote from *C. granularis*, and *C. conoidea*, Schk., to be confounded with them.

No. 202. *C. Knieskernii*, Dew.

Spica staminifera unica cylindracea longa pedunculata, squamis oblongis obtusis conferta; spicis pistilliferis ternis, *tristigmaticis*, longo-cylindraceis, sublaxifloris, subdistantibus, subrecurveo-pedunculatis, basi vaginatis; fructibus ovatis, oblongis, subtriquetris, terete-conicis, rostratis, brevi-bidentatis, squama ovata oblonga obtusiuscula brevi-mucronata paulo longioribus; foliis bracteisque minute pubescentibus.

Culm a foot or more high, erect, leafy towards the base, sheaths partly inclosing the peduncles long and leafy, and with the leaves slightly pubescent; staminate spike commonly long and cylindric with oblong and obtuse scales; stigmas three; pistillate spikes three, long and cylindric, rather loose-flowered, long recurved pedunculate; fruit ovate, oblong, tapering above into a beak, bidentate, subtriquetrous; pistillate scale ovate, oblong, obtusish, often slightly mucronate, white and hyaline with a green keel; plant pale green, reddish at the base.

In woods near Oriskany, Dr. Knieskern. Since found near Rome, and near the former locality by Mr. Vasey. It is closely related to *C. sylvatica*, and has been confounded with *C. arctata*, Boott, from both which it is clearly different; from *C. Sullivantii*, Boott, it is far separated.

The name is proposed by Mr. Vasey in honor of Dr. Knieskern, well known as a botanist.

No. 203. *C. Halei*, Dew.

Spica decomposita subpaniculata magna inferne ramosa; spiculis ovatis, aggregatis, plurimis compactis, superne staminiferis, sessilibus; fructibus brevi-ovatis, *distigmaticis*, perlongo-rostratis, nervosis, divergentibus, convexo-concavis, squama ovata acuta triplo longioribus; culmis foliaceis et cum foliis scabris.

Culm 18–30 inches high, triquetrous, rough on the edges, erect, leafy towards the base; leaves long, scabrous on the edges, surpassing the culm and striate; spike compounded of many sets of spikelets, ovate and aggregated and staminate at the apex; stigmas two; fruit short ovate with a very long slender beak, nerved and small, beak very scabrous on the edges; pistillate scale ovate, acute, hyaline on the edges, and scarcely one third the length of the fruit; plant light green; lower part of the spike subpaniculate.

Louisville, Ky., Dr. Short; swamps of Mississippi river in Louisiana, Dr. Leavenworth and Dr. Hale. Confounded with *C. stipata*, from which it is clearly distinguished by its fruit and scale. In *C. stipata* the fruit is a regular taper from the base to the vertex or has a triangular outline, and its form is entirely different from this, as well as the relative length of the beak and the scale.

No. 204. *C. heterostachya*, Torr. in literis.

Spica staminifera unica cylindracea pedunculata, cum squamis oblongis obtusis conferta; spicis pistilliferis 2–4, tristigmaticis, cylindraceis, stricto-floris erectis, raro apice staminiferis, superiore incluso-bracteatis, inferioribus remotis vel perremotis, exserte pedunculatis, brevi-vaginatis; fructibus brevi-ovatis, conicis, subtriquetris, nervosis, ore integris, squama ovata acuta paulo longioribus; foliis lineari-lanceolatis subradicalibus, bracteis lanceolatis foliosis.

Culm 4–8 inches high, erect, slightly triquetrous, stiff, leafy at the base, with broad leafy bracts; staminate spike single, long pedunculate, with oblong and obtuse scales white on the edges and brown on the back; pistillate spikes 2–4, about three, cylindric, rather close-flowered, rather distant, with peduncles partly inclosed in the sheaths, the upper nearly sessile; stigmas three; fruit short-ovate, conic, nerved, entire at the orifice; pistillate scale ovate, acute, a little shorter than the fruit, the lower some-

times mucronate and about the length of the fruit; plant light green; bracts much wider than the leaves and lanceolate.

Drummond Island in Lake Huron, Dr. Torrey; Macomb Co., Michigan, Dr. Cooley. A distinct species.

No. 205. *C. Woodii*, Dew.

Spica staminifera unica, triquetra, oblongo-cylindracea, squamo-bracteata, cum squamis oblongis obtusis densis; pistillifera *tristigmatica*, unica, interdum binæ, ovato-oblonga, laxiflora, superiore exserte pedunculata, erecta, inferiore remota, perlongo-pedunculata, recurva laxa; fructibus obovatis, obtusis subtriquetris, ore strictis erostratis, inferne teretibus, squama ovata subacuta duplo-longioribus; culmo tereti laxo, foliis angustis linearibus striatis; foliis et culmis exigue pubescentibus.

Culm a foot or more high, slender, triquetrous, lax, striate; leaves of the culms short, striate and subradical, but of the roots very long, slender, flat; staminate spike single, triquetro-cylindric, oblong, an inch long, with oblong and obtuse tawny scales, the lowest subbracteate; pistillate spike, 1–2, ovate, short, loose-flowered, upper one sheathed and exsertly pedunculate, the lower very long pedunculate and lax; fruit obovate, obtuse, triquetrous, orifice closed, tapering below, with its scale ovate acutish and half as long as the fruit, and white with a green keel; plant light green, and very slightly pubescent.

Found by Drs. Crawe and Wood on Perch Lake and Peck River, Jefferson Co., N. Y., and named after one of its discoverers, Dr. Wm. A. Wood. It appears to be very distinct.

Rochester, N. Y., March, 1846.

ART. XXVII.—*On three new Mineral Species from Arkansas, and the Discovery of the Diamond in North Carolina;* by CHARLES UPHAM SHEPARD, M. D., Prof. of Chemistry in the Medical College of South Carolina, and in Amherst College, Massachusetts.

FOR the minerals here described from Arkansas, I am indebted to my friend, the Rev. E. R. Beadle, formerly missionary to Palestine, but at present, a resident in New Orleans. I believe them to have been collected by himself, during a late journey through the region of the Hot Springs.

1. *Arkansite.**

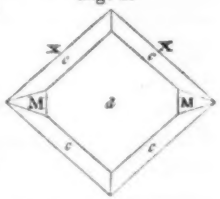
Primary form. Right rhombic prism. M on M, 101°.

Secondary form. M on *c*, 133° 45′.

c on *c* over the edge x } 135 15 †

edge x inclines to edge x at about 94°.

Fig. 1.



Cleavage indistinct. Surface, M brilliant, *c* less so, *d* brilliant, though drusy, and channelled vertically. Fracture sub-conchoidal, to uneven. Lustre metallic. Color dark steel-gray to iron-black. Faces *c* tarnished blue, like specular iron. Streak dark ash-gray. The powder (until it becomes perfectly fine) shows points with a metallic lustre.

Brittle. Hardness = 7·0—7·5.

When heated in a glass tube, the mineral affords no traces of moisture, or of hydro-fluoric acid. Alone, before the blowpipe, on charcoal, it is unalterable. With borax, it enters slowly into fusion, and gives a transparent, deep yellow glass.‡

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* Named from the State in which it is found.

† None of these angles were obtained from perfect reflections.

‡ A crystal weighing 0·68 gr. in the state of powder, was boiled for an hour in sulphuric acid, during which it underwent decomposition. The yellowish green insoluble matter separated, was thrown upon the filter and subsequently ignited. Its color became pale straw-yellow. Its weight was 0·32 gr. It afforded the reactions of titanic acid. The sulphuric solution (having been found to afford a precipitate with sulphate of potassa, which was soluble by addition of more of the saturated solution of sulphate of potassa) was precipitated, ignited and weighed. It amounted to 0·28 gr., and had the properties of yttria, though it is possible there might have been some intermixture of zirconia and thorina.

In a second trial, 1·68 grs. were fused with 12 grs. bisulphate potassa. The resulting mass had a faint tinge of yellow. It was boiled in excess of water, from which a fine, white, heavy powder was precipitated. Mingled with this powder was another, rather heavy, flocculent, grayish white matter, in small quantity, which remained behind in the basin as the other was removed to the filter by a stream from the wash-bottle. Sulphuric acid was boiled upon it without producing any change; but it afterwards slowly disappeared on being digested with hydrochloric acid. From a portion of this solution, ammonia threw down a precipitate, resembling yttria. The titanic acid, separated from the original sulphuric solution, weighed after ignition, 1·14 gr., or 67 p. c.

So far as my examination went, (which was restricted for want of material to examine, and the circumstance that my means for such inquiries were at the time, in Amherst,) I am led to regard the substance in question as a *titanate of yttria*, in which neither lime, oxide of cerium, iron or manganese are present.

The crystals are about one-fifth of an inch in diameter; and are implanted upon quartz crystals, which last are attached to a surface of a brownish green coccolite. The quartz crystals are dark brown within, but coated by a thin layer of milky quartz; and are about one inch in length, by one-fifth of an inch in diameter.

The ticket to the specimen is marked thus: "Magnet Cove. T 35. R 17 W. S 21. Hot Springs Co., Arkansas."

2. *Ozarkite.**

Massive. Composition, laminæ (confused) nearly impalpable. Fracture uneven.

Lustre feeble, vitreous to resinous. Color white (rarely bluish) to flesh-red. Streak white. Translucent.

Brittle. Hardness 4·5. Specific gravity, 2·746.

Heated in a glass tube before the blowpipe, it emits water very freely. (Ignited in the state of powder, it loses 15·1 p. c., and the powder is left slightly cohering.) Alone before the blowpipe, it melts almost with the facility of cryolite, into a transparent colorless glass. With borax, it dissolves into a transparent glass.

It dissolves freely without effervescence, in nitric and in hydrochloric acid, with deposition of silicic acid; and appears to be a siliceous hydrate of lime and yttria, possibly also having traces of thorina.

It occurs diffused in irregular veins and ovoidal masses (about one-fourth of an inch diameter) through a flesh-colored elæolite, from which mineral however, it is constantly separated by a thin layer of a red jasper-like substance, which is obviously distinct from the two minerals it tends to separate; and may itself be an undescribed species. Its locality, like that of the Arkansite, is Magnet Cove, Hot Springs Co., Arkansas.

3. *Schorlomite.*†

Primary form. Rhomboid. Dimensions unknown.

The species standing in the nearest relation to it, would seem to be the Æschynite, which however is a titaniate of zirconia and cerium; but the properties of the two minerals when contrasted, will at once show the impossibility of their being included within the same species.

* Named from the Ozark Mountains, in which extensive range its locality is situated.

† From *Schorl*, a familiar variety of tourmaline, and ομοῖος, *like*, from its resemblance in color, fracture and crystallization to that mineral.

Secondary form. Hexagonal prism, with lateral edges truncated by narrow and brilliant planes.

Cleavage indistinct. Fracture conchoidal. Surface of the broader planes rather dull, of the narrow ones smooth and brilliant.

Lustre vitreous. Color black. Streak grayish black, with a tinge of lavender-blue. Tarnished with blue and pavonine tints, thus causing it to resemble specular iron, (for which substance it had been mistaken.) It also strikingly resembles some varieties of bluish black, massive, or imperfectly crystallized, tourmaline.

Hardness = 7·0—7·5. Specific gravity = 3·862.

Heated in a glass tube, it emits a little moisture, and glows with redness, immediately as the tube on which the fragment rests, becomes red. Its powder loses 3 p. c. on being ignited. Alone on charcoal, it fuses readily (and with scarcely any perceptible effervescence,) into a shining obsidian-like globule, which is not affected by the magnet. With borax, it gives a transparent glass, slightly tinged green by iron.

It is easily decomposed by the acids,—gelatinous silica being separated. It consists essentially of silicic acid, yttria, thorina,(?) oxide of iron and water. I could not detect in it, either oxide of cerium or lantanum.

It approaches in some of its properties the species allanite and gadolinite; from both of which it is sufficiently distinct however to entitle it to a specific rank.

The specimen affording it, is the same with that last referred to, as embracing the ozarkite. The crystals are very minute; but a large mass of the mineral occurs in elæolite, more than two inches in diameter, and which appears to belong to a single individual, which (like the indicolite crystals of Goshen) has been much interpenetrated by the gangue, so as on the whole to have less perhaps than one-half of the outline of the crystal occupied by the pure mineral. Fragments of pure schorlomite an inch in diameter, however, may be detached from this skeleton-crystal.*

* The elæolite with which this and the foregoing species are found, and which had been called a compact red feldspar, is a remarkably well characterized variety; is perfectly fresh and unaltered, forming a grayish flesh-red, oily, translucent mineral. Its sp. gr.=2·60. H.=6·0. It is fusible into a colorless glass, and in a state of a powder, at once forms with warm nitric acid, a flesh-colored jelly.

The same rock contains (and particularly the ozarkite and schorlomite portions of it) a yellowish-brown, semi-transparent, resinous mineral, which unless it should prove to be xenotime, may constitute a new species. It is highly crystalline; but the crystals are too small and incomplete to permit their determination. In hardness, it does not exceed 6·0.

4. *Diamond in North Carolina.*

At the 6th annual meeting of the Association of American Geologists and Naturalists, held in April, 1845, in this city, I made known the existence of the true, diamond-bearing rock (the Itacolumite) at several places within the gold region of the United States; and predicted that we should soon have other discoveries of the diamond within the range of this formation, in addition to the well authenticated one then already made, in Hall Co., Georgia. This opinion was circulated to some extent, by means of the newspapers in North Carolina; and as one of the first fruits of the inquiry set on foot, I had the pleasure of receiving last spring while in Charleston, from my friend the Hon. Mr. Clingman, of Asheville, Buncombe Co., the diamond here figured and described.* It was found in the gold washings of Mr.

It may not be without interest to annex here also notices of several other specimens forwarded by Mr. Beadle from the same region.

a. Gray granite (without quartz) with black mica in small scales, imparting to the rock the aspect of a sienite. It contains everywhere diffused through its mass, minute, hyacinth-red crystals, having the hardness of monazite. From Fourche Cove, Pulaski Co. T 1 N. R 12 W. S 34.

b. From same place, (T 1 N. R 12 W. S 33.) a coarse amygdaloidal basalt, containing thickly implanted crystals of grayish black pyroxene, above an inch in length, and much resembling those found at Aussig, in Bohemia.

c. From little Missouri, Pike Co., (T 8 S. R 25 W. S 30.) Granular and fibrous snowy gypsum.

d. From do., (T 8 S. R 25 W. S 27.) Coarse granular and crystallized celestine, in large masses.

e. From do., (T 8 S. R 25 W. S 30.) Grayish white, granular celestine. Also in confusedly aggregated crystals, with rough, drusy faces.

f. From do., (T 8 S. R 26 W. S 16.) Celestine in large masses, crystallized and granular.

g. From do., (T 8 S. R 25 W. S 27.) Heavy spar in grayish white, tabular crystals and laminated masses, diffused through a steatitic clay.

h. From do., (T 8 S. R 25 W. S 27.) A yellowish white steatite, analogous to that found in Cornwall, England.

i. From same region, (T 8 S. R 25 W. S 27.) A trachytic porphyry. It has the dry, harsh feel, and emits the peculiar odor (when moistened) of the European trachytes. It is said by Mr. Beadle to be as recent as the tertiary.

j. From Saline Co., (T 2 S. R 16 W. S 14.) Compact reddish dolomite (had been supposed to be spathic iron) in quartz.

k. From Spring, (T 3 S. R 18 W. S 17.) Hot Springs Co. Light greenish grey trap-porphyry. A trachytic rock, with large, flat and perfect crystals of feldspar, slightly reddish. They resemble the ryakolite of Bohemia.

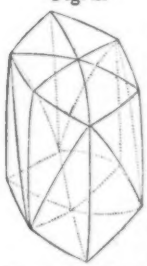
l. From Magnet Cove. (T 3 S. R 17 W. S 19.) A ryakolite-porphyry with a dark green basis. The rock contains little specks of a rich, azure blue mineral, which I am unable at present to determine.

* It is the crystal to which allusion was made in the last number of this Journal, p. 119.

Twitty's mine in Rutherford Co.; which mine is situated in the Itacolumite region I had designated in the communication above referred to. Mr. Clingman thus refers to it in a letter dated Feb. 17th, 1846. "By the desire of Mr. Twitty, I have enclosed to Dr. Dickson, (with the request that he would present it for examination to you;) a small crystal which seemed to me to possess the adamantine lustre, and was hard enough to scratch every thing to which I applied it, it cutting limpid quartz easily. Should you find it to be a diamond, would you regard the picking up of a single one among the gravel from a gold-rocker, as affording a sufficient inducement for instituting a search for diamonds at that place?"

Although there could be no mistake about the hardness and lustre possessed by this crystal, *i. e.*, that they could only belong to the diamond, still there was something in its singularly elongated shape, which at first sight was calculated to remind one of an hexagonal prism with trihedral summits, such as occurs in calcite, or tourmaline: but then the faces were each diagonally divided by a slightly raised edge; and besides, they all equally had the peculiar sphericity so frequent in the diamond. The crystal however, which is bounded by twenty-four isosceles triangles, is plainly enough a common secondary of the cube, through the bevelment of its edges; and its unusual figure arises from the disproportionate extension of the twelve planes situated about its vertical axis. See the figure in the margin.

Fig. 2.



Its weight is 4·12 grains, and its specific gravity=3·334. It is transparent, possessing only a faintly pale yellowish tinge of color; and it is nearly without flaw.

It is to be hoped that the proprietors of gold washings throughout the district, will immediately set on foot a systematic search for this precious gem, which, in the ordinary operations of gold mining, might be overlooked to almost any extent. Henceforth there can scarcely remain a doubt, but that the diamond is to form a part of the available mineral wealth of the country.

New Haven, July 21, 1846.

SCIENTIFIC INTELLIGENCE.

I. Chemistry.

1. *On the Electrical Conductibility of certain bodies;* by Ed. Becquerel, (Comptes Rendus, March 1846.)—It has been shown that the coefficients representing the relative conductibility of different substances, do not answer for different degrees of temperature; thus at 32° Fahr., silver conducts about 57 times more readily than mercury, while at 212° Fahr. the comparative conductibility of these two metals is as 44 to 1; the same amount of heat creating a much greater relative resistance in the silver than in the mercury. From the author's experiments the following table has been constructed.

Conducting power compared with that of silver at 32° Fahr.		Conducting power at 212° Fahr. compared with that of silver at 212° Fahr.	
	At 32° Fahr.	at 212° Fahr.	
Pure silver, (annealed)	100·	71·316	Silver, - - 100·
" copper, " -	91·517	64·919	Copper, - 91·030
" gold, " -	64·960	48·489	Gold, - - 67·992
Cadmium, - -	24·579	17·506	Zinc, - - 24·673
Zinc, - - -	24·063	17·596	Cadmium, - 24·547
Tin, - - -	14·014	8·657	Tin, - - 12·139
Iron, - - -	12·350	8·387	Iron, - - 11·760
Lead, - - -	8·277	5·761	Platinum, - 9·378
Platinum, - - -	7·933	6·688	Lead, - - 8·078
Mercury, - - -	1·739	1·5749	Mercury, - 2·208

J. Lawrence Smith.

2. *Liberation of Electricity by the bursting of a Bladder;* (Chemist, April, 1846.)—Mr. J. Duprey has shown that in the well known experiment of bursting a bladder stretched over the mouth of a vessel, by the air pump, electricity is always liberated, and that it is of a positive character. It is shown by passing a brass rod through the side of the receiver, into which it is cemented, the inner end terminating with a knob, the outer being connected with an electroscope. J. L. S.

3. *Appreciation of the Force of Magnets;* by M. de Haldat, (L'Institut, No. 647, May 27, 1846.)—M. de Haldat has contrived a means of ascertaining the force of magnets, based on the influence exerted at a distance from a needle. The apparatus is extremely simple; it consists of a rule two to three meters long and three to four decimeters in width, subdivided into centimeters, and divided into two equal parts by a longitudinal line. A delicate needle twelve to fifteen centimeters in length, is fixed on a pivot on the meridian line; and a point of copper is adapted to it, to indicate by its coincidence with the ex-

tremity of the horizontal needle, the magnetic normal. The rule is placed horizontally and in an east and west direction, perpendicular to the magnetic meridian. In using it the magnet is made to approach the needle parallel with the sides of the rule. The distance at which it acts on the needle indicates its sphere of activity, as compared with any other magnet that may be operated upon. Not only different needles may be thus compared, but the different poles of the same magnet; and as the force diminishes as the square of the distance, the different lifting forces of magnets of equal transverse sections may be deduced. M. de Haldat, with the same means, has experimented on the effects of interposing different media between the magnet and the needle; and he finds no appreciable difference, whatever substance he used, or however great its thickness. This was true of iron as well as other substances. He has ascertained the singular fact, (an exception to the usual law of the propagation of these subtle fluids,) that the union of two magnets of equal intensity, although producing an increase of lifting force, does not increase the sphere of activity. The sphere of activity therefore cannot be enlarged except by adding a magnet of greater intensity, and then will equal that of this stronger magnet alone. This fact is likewise confirmed by the *magnetic phantom*, in which the rays and characteristic curves are made more distinct and beautiful by the uniting of two magnets, but the extent of the figure, produced by the action, is no greater than with one.

4. *Calorific Power of the Light of the Moon;* (A letter from M. Melloni to M. Arago, and Chemist, May, 1846.)—M. Melloni has shown, beyond a doubt, that the rays of the moon are calorific to a slight extent. It was done by concentrating the rays of the moon with a lens over three feet in diameter, upon his thermoscopic pile. The needle was found to deviate from 0°·6 to 4°·8 according to the phase of the moon. Numerous precautions had to be attended to so as to avoid all error arising out of currents of air, &c. J. L. S.

5. *On the Cohesion of Liquids and its effect upon the phenomenon of Ebullition;* by F. Donny, (Annales de Chem. et de Phys., Feb. 1846, p. 167.)—These experiments disclose some very remarkable circumstances connected with the cohesion of the particles of liquids. They were undertaken upon the author's observing that a syphon gauge constructed by him with sulphuric acid, (perfectly free from air,) for the purpose of testing the airpump vacuum, was useless; the acid remaining stationary, being sustained by the adhesion of the acid to the tube and the cohesion between its own particles;—and by means of these forces alone, he succeeded in sustaining a column of sulphuric acid (free from air) four feet in height, even in a perfect vacuum, and notwithstanding the apparatus being repeatedly agitated.

With distilled water *free from air*, the same phenomenon was observed, and by a series of comparative experiments the author is led to believe that cohesion alone can sustain a column of water over 33 feet. It is the absence of air alone that allows the particles of liquids to approach each other more closely, and exercise more powerfully their cohesion, which, when air is present, interferes but slightly with the changes that liquids undergo, as for instance ebullition, that happens at about the temperature at which their vapors enter into equilibrium with the atmospheric pressure. But if water is as free from air as it is possible to make it, it can be *heated to the temperature* 275° *Fahr. without manifesting the slightest traces of ebullition, and that, even in a vacuum;*—this remarkable fact has been proved by experiment, the instrument used for it being a kind of water hammer,—so arranged that the vapor in the upper part could not be heated, and thereby exercise a pressure upon the water,—which was heated to 275° Fahr. without the adhesion of the particles giving way; showing that this force was superior to the pressure of three atmospheres, as under ordinary circumstances, water, heated to 275°, furnishes a vapor equal to that pressure.

But if the water heated to this high temperature be divided in any way, steam is disengaged instantly and with great violence, the temperature at the same time falling. In this way those sudden bursts of vapor, which are often so annoying during the evaporation of liquids, are explained. At the first part of the ebullition while air is present the vapor is uniformly produced, the temperature of water and vapor being the same; but the air once gone, the cohesion of the liquid interferes in the process; this induced the author to try what effect a current of air passing through the liquid would have in preventing these explosions, which resulted in perfect success.

M. Donny thinks that the cause of certain explosion of boilers, may be deduced from these facts, and proposes as a means of preventing them, to throw in at the bottom of the boiler a small stream of air.

These experiments have an important bearing upon the point of ebullition of liquids. It is impossible to enter more into detail concerning these interesting researches, which extend over more than twenty pages, but which recommend themselves to the perusal of chemists and natural philosophers. J. L. S.

6. *A New Method for the Quantitative Determination of Iron;* by M. MARGUERITE, (Comptes Rendus, April, 1846.)—This method is based upon the fact, that when a solution of the permanganate of potash—the chameleon mineral—is added to a solution of the protoxide of iron, the former is discolored so long as any of the latter metal remains in the state of protoxide. With this in view the author proceeds as follows. 1. Dissolve the ore in hydrochloric acid. 2. Convert the persalt of

iron into a protosalt by the addition of sulphite of soda, and boil the solution to expel the excess of sulphurous acid; it is important that none of this latter substance should be present when the next step in the operation is made, this can always be ensured by having an excess of hydrochloric acid. 3. Add, with precaution, from a graduated vessel a solution of the permanganate of potash, the strength of which is known, and by reading off the number of divisions consumed, before any pink tint appears in the solution of iron, the amount of this latter metal present is calculated; in this part of the process, it is necessary to have the solution very dilute.

The manner of preparing this test liquid is as follows.—The chameleon mineral is first prepared as proposed by Gregory; by fusing together chlorate of potash, hydrate of potash, and peroxide of manganese in the proportion of one atom of the first, three of the second, and three of the third. The fused mass is treated with water, so as to obtain a concentrated solution to which is afterwards added dilute nitric acid until it acquires a violet color;—the solution is now filtered and ready for use. To obtain it of the proper strength, dissolve one gramme of pure iron in hydrochloric acid, dilute with about one quart of water, and add from a graduated vessel the solution of chameleon mineral, until the pink color appears; noting the number of divisions of the solution consumed, we are then in possession of all the data necessary for future analysis.

None of the substances associated with the ores of iron interfere with the accuracy of the result, except copper and arsenic, both of which are got rid of by adding a piece of zinc to the solution of the ore in hydrochloric acid before it is treated with the sulphite of soda.

J. L. S.

7. *On the Quantitative Determination of Mercury;* by E. Millon, (Annales de Chem. et de Phys., 1846, and Chem. Gaz., March, 1846.)—A long glass tube, such as is used in organic analysis, is first contracted near to one of its extremities, and at the very extremity drawn out to a point and curved upwards; the space between the two contractions being from three to four inches. A small quantity of asbestus is introduced into the tube next to the point first contracted, and upon this are placed fragments of caustic lime to the extent of six or eight inches; the mercurial compound is next introduced varying from 15 to 60 grains, and then the tube is filled with caustic lime similar to the other. In the analysis of nitrate of mercury, the lime should be replaced by metallic copper. The tube is now placed in the furnace used for organic analysis. A current of pure hydrogen (purified by passing the dry gas over copper turnings heated to redness) is made to enter at the uncontracted extremity, and the heat applied exactly as in organic anal-

ysis. The water is first seen on the portion of the tube between the contractions; it is dissipated by gently heating it; this part of the tube is then allowed to cool, and the mercury soon makes its appearance, condensing in its turn without any difficulty. At the end of the operation, the part of the tube containing the mercury is separated by slightly moistening the heated tube; the portion of the tube is weighed with the mercury it contains, the mercury poured out, the particles adhering to it removed by nitric acid; it is then washed, dried, and weighed again. The difference of the two weights gives the weight of the mercury. J. L. S.

8. *A New Method of estimating Copper;* by M. PELOUZE, (Comptes Rendus, Feb., 1846.)—It is based upon the discoloring of a solution of a persalt of copper in ammonia by any deoxydizing agent. The following is the method of procedure. One gramme of pure copper is dissolved in half an ounce of nitric acid, the solution diluted with a little water, and slight excess of ammonia added. A solution of sulphuret of sodium in water is next made, (Pelouze used about 4 oz. to a quart of water—this however is altogether arbitrary,) poured into a graduated tube, and let fall drop by drop upon the solution of copper, heated to boiling, until the discoloration is complete. The quantity of sulphuret used is noted, and it then becomes a standard solution, of which so many divisions of the graduated tube are required to discolor one gramme of copper.

If we now wish to analyze an alloy of copper, it is dissolved in nitric or nitro-muriatic acid, super-saturated with ammonia, heated to boiling, and discolored by the solution of sulphuret; the required quantity of which is noted, and from our knowledge of the amount required for one gramme of copper, we estimate the quantity of this metal present.

By this method M. Pelouze says that we can approximate to within one-half per cent., and even less if great care be observed. The presence of tin, zinc, lead, arsenic and antimony, do not interfere with the accuracy of the result; nickel and cobalt will. The solution of sulphuret slowly undergoes alteration by contact with the atmosphere, so that it is necessary prior to each assay, to test the strength of the sulphuret by a known weight of copper. J. L. S.

9. *A new test for Manganese;* by R. PHILLIPS, (Chemist, April, 1846.)—Place the solution of manganese in a bottle, so that it may cover the bottom of the phial to the depth of about the tenth of an inch, and lay on the fluid a common stick of phosphorus, by which means one half of the stick will be exposed to the air; the mouth of the bottle should be but imperfectly closed. After keeping the bottle in the dark for a few hours, the fluid will be found to possess a beauti-

ful amethystine tint, if it contains any manganese; by exposure to the light of the sun the fluid soon becomes colorless, but the color may be again renewed by placing the bottle in the dark. J. L. S.

10. *Separation of Cobalt from Manganese;* (Journ. de Pharm, March, 1846.)—M. Barreswil has taken advantage of the fact that sulphuretted hydrogen will precipitate cobalt from a perfectly neutral solution of all its salts, but not the manganese. The object to be arrived at, is to keep the solution neutral as the cobalt is precipitated, which is done as follows:—An excess of carbonate of baryta is added to the solution containing the cobalt and manganese, and through it the sulphuretted hydrogen is passed. The cobalt is precipitated, the manganese remains in solution, and the carbonate of baryta keeps the solution neutral without interfering with the result. The rest of the analysis is conducted in the ordinary way. J. L. S.

11. *Upon the Precipitation of different Organic and Mineral Substances by Animal Charcoal;* by M. Weppens, (Rev. Scientifique, Feb., 1846, p. 251.)—The animal charcoal used was prepared from bones, and washed repeatedly with boiling hydrochloric acid in order to dissolve the phosphate of lime. Thus prepared it precipitates bitter extracts, resins, and astringent substances from solution. 5 parts of colocynth, gentian, columbo, and quassia being infused in 600 parts of water, this latter was completely deprived of its bitter taste by 16, 10, 5, and 16 parts of charcoal respectively for the four substances mentioned. 600 parts of water containing $1\frac{1}{2}$ of aloes was rendered tasteless by $2\frac{1}{4}$ parts of charcoal. The sulphates of copper, zinc, chrome, iron, the nitrates of mercury, nickel, cobalt, silver and other metallic salts are to a certain extent precipitated by animal charcoal. J. L .S.

12. *On the Incandescence of Iron, Copper, Brass, &c., in the Vapor of Alcohol;* by Prof. Böttger, (Annalen der Pharm. und Chem., Jan., 1846.)—Dr. Riensch has lately discovered that the above metals heated to a certain point, would, under favorable circumstances, glow in the vapor of alcohol. Prof. Böttger endeavors to show that this phenomenon is not attributable to the metals themselves, but rather to their oxides, for he says every one who has performed the experiment as described by the author, must have found that it requires a long time for it to succeed perfectly, and when it is successful it will be found that it is owing to the surface of the iron having become oxydized. He farther states, that a coil of wire, which from repeated use has been superficially converted into oxide, will glow in the vapor of alcohol quite as well as pure metallic platinum. J. L. S.

13. *A New and Simple Method of preparing Chloric Acid;* by Prof. Böttger, (Annalen der Chem., Jan., 1846, and Chem. Gaz., March, 1846.)—A solution of chlorate of soda is first prepared by decompo-

sing bitartrate of soda with chlorate of potash, in the following manner:—seven parts by weight of crystallized carbonate of soda, and 7½ parts by weight of tartaric acid, are dissolved in twenty-four parts of boiling water, and to this boiling solution is added six parts by weight of chlorate of potash previously dissolved in sixteen parts of water likewise heated to 212° F., at the same time agitating the mixture. As soon as this is done, it is taken from the fire and allowed to cool, in order that the bitartrate of potash formed may separate properly; after which it is poured on a double paper filter, and to the filtered liquid is added a saturated solution of oxalic acid, consisting of six parts by weight of oxalic acid, and eighteen parts of water heated to about 134° F.; the whole is then well agitated, and the vessel placed in an ordinary refrigerating mixture, for the better separation of the oxalate of soda, which is then entirely and easily removed by a simple filtration. This method is based upon the superior solubility of the chlorate of soda over the same salt of potash, and upon the sparing solubility of the oxalate of soda. The chloric acid thus obtained is, it is true, not absolutely pure, but still sufficiently so for most chemical and technical purposes—for instance, for the preparation of chlorate of barytes, which is so much consumed in the manufacture of fire works. To obtain a chemically pure and at the same time more concentrated acid, the solution above obtained should be treated with recently precipitated carbonate of baryta, avoiding any rise of temperature; but the solution of the barytic salt may now be evaporated over the fire, and the large beautiful crystals which soon form are pulverized, dissolved in water, and decomposed with a corresponding quantity of sulphuric acid. J. L. S.

14. *A ready Method of preparing Hypochlorous Acid;* by M. Williamson, (Journ. de Chem. Med., March, 1846.)—Saturate a neutral solution of sulphate of soda, at the ordinary temperature, with chlorine. A large amount of chlorine will be absorbed, and the liquid will contain bisulphate of soda, chloride of sodium, and hypochlorous acid. If the liquid be distilled, the hypochlorous acid will come over with the first portions of water. This acid will be found very useful in the laboratory, as it possesses an oxydizing agency superior to nitric acid at the ordinary temperature. J. L. S.

15. *Preparation of Chromic Acid;* by M. Bolly, (Annal. der Chem. und Pharm., vol. lvi, p. 113.)—This is a modification of Fritzsche's method, and is based upon the fact that concentrated sulphuric acid precipitates chromic acid from solution if a little water be present. Take a weighed portion of bichromate of potash and make a boiling saturated solution; during ebullition, add sufficient concentrated sulphuric acid to form bisulphate with the potash of the chromate. Decant the

liquid portion from the granular mass, add repeatedly small portions of water to the granular mass and decant, until the residue of bisulphate is of an orange color. Unite the portions decanted, concentrate by evaporation, precipitate the chromic acid by sulphuric acid, throw it upon a funnel and let it drip, spread it on porous bricks, redissolve and crystalize. In this way large crystals of the pure acid can be obtained. The solution of chromic acid in sulphuric acid is a powerful oxydizing agent.

J. L. S.

16. *Preparation of the Phosphuret of Nitrogen;* (Rap. Annuel de Berz., 1845, p. 40.)—M. Balmain has pointed out the following method which furnishes very readily the substance in question. Heat gently in a flask, chloramide of mercury, and then add phosphorus in small pieces so long as any reaction takes place. Agitate from time to time, and complete the operation by heating the bottom of the flask to redness. The sal-ammoniac, excess of phosphorus, and mercury, is volatilized, and the phosphuret of nitrogen remains behind. J. L. S.

17. *Economical Method for preparing the Protoxide of Copper;* by M. Wittstein, (Revue Scient., Feb., 1846, p. 258.)—Dissolve 1 part of sulphate of copper and 1 part of sugar of milk in 10 parts of water, and add to the cold solution a solution of caustic potash until the precipitated hydrated oxide of copper is redissolved by agitating the liquid. The blue solution is heated in a water bath, it being kept constantly agitated. In a very short time the color passes to a grayish green, and a precipitate begins to appear, which is at first brown, but becomes finally of a cinnabar red color. So soon as this happens, withdraw the vessel from the fire, and place it in cold water to facilitate its cooling; after which it is readily collected on a filter. If the action of heat be continued its color becomes changed. J. L. S.

18. *Amount of Carbon expired by Man;* by E. A. Scharling, (Annal. der Chem. und Pharm., vol. lvii, p. 1.)—These researches have reference to the amount of this substance expired by the skin as well as by the lungs.

	Carbon from the lungs in one hour.	Carbon from the skin in one hour.
	Grains.	Grains.
Adult of 28 years, . .	174·7	5·74
Young man of 16 years, .	166·4	2·78
Boy of 10 years, . . .	98·9	1·90
Young girl of 19 years, . .	123·7	4·20
" " " 10 years, . .	95·7	1·90

J. L. S.

19. *Mode of dividing plates of Zinc;* by M. Waidele, (Revue Scient., Feb., 1846, p. 257.)—It is frequently a subject of great annoyance to divide plates of cast zinc used in galvanic batteries. The follow-

ing is a simple and ready method of accomplishing this end. Grease the plate over by means of a rag and a little tallow,—with a pointed instrument draw a line in the required direction of the cut, so as to remove the grease from that spot, and penetrate slightly into the metal,—pass a little dilute sulphuric acid over this line by means of a feather, and then let a drop or two of mercury fall on the same spot,—the zinc soon becomes amalgamated in the direction of the line, and through its entire thickness; a slight blow properly given will cause it to break.

J. L. S.

20. *On the Presence of Carbonates in the Blood;* by R. F. MARCHAND, (Journ. für Prakt. Chem., April, 1846, and Chem. Gaz., June, 1846, p. 213.)—In these experiments the author endeavors to substantiate his former opinion upon this subject, which is in opposition to that of many chemists. One of the methods by which he proceeded to establish the presence of carbonates in the blood was as follows:—

The mass obtained by evaporating five pounds of blood in a retort, was conveyed into a long-necked flask, closed with a cork, through which a long funnel and a tube for conducting away the gas were inserted; the latter was fitted air tight into a Woulf's bottle, which was half filled with a clear solution of barytes. On heating the liquid in the flask to gentle ebullition, the steam passed through the barytic solution, causing not the slightest turbidness during the course of half an hour; but on pouring dilute sulphuric acid through the funnel, and continuing the gentle boiling, a white precipitate very soon appeared which subsided in dense flakes, and after separation from the clear liquid, dissolved entirely in a little hydrochloric acid, so that the precipitation could not have arisen from any sulphuric acid having been carried over. The author repeated this experiment three times and always with the same result; so he thinks himself justified in his conclusions concerning the presence of carbonates in the blood. J. L. S.

21. *On the presence of Sulphocyanogen in Human Saliva;* by MAX. PETTENKOFER, (Buch. Rep. xli, p. 289, and Chem. Gaz., May, 1846, p. 191.)—As authors are not agreed upon the occurrence of Sulphocyanogen in the saliva, Gmelin, Ure, Liebig and Wright, speaking in favor of it, whilst Berzelius, Kühn and Müller are opposed to it, it appeared requisite to the author to investigate the subject again. The saliva used was collected from the author himself, and its secretion was promoted by smoking tobacco.

The saliva in its examination was evaporated almost to dryness, exhausted with strong spirits, again evaporated and the residue dissolved in water. The solution was very strongly reddened by neutral chloride of iron and let fall some brown flakes, but it could not be caused to disappear by the addition of chloride of sodium or ammonium. The ex-

tract was boiled with sulphuric acid, and a moist piece of lead paper held over it, which latter was rendered brown by sulphuretted hydrogen. It was submitted to other characteristic tests for sulphocyanogen and responded to all of them.

The mode of formation of the sulphocyanogen in saliva has hitherto proved a stumbling-block; but if we regard urea as a cyanate of ammonia, C^2NO+NH^4O, and compare the formula of sulphocyanide of ammonium with it, $C^2NS^2+NH^3$, we find a striking relation between them; for if we place 2 equiv. of oxygen in the urea by 2 equiv. of sulphur, we have the elements of sulphocyanide of ammonia. Moreover, the products of decomposition of the two substances on destructive distillation are to a certain extent similar. The author has also found that urea may be converted into a compound of sulphocyanogen by the action of alkaline sulphurets. Since the urea occurs already formed in the blood, it would not appear improbable that by combining in the salivary glands with the sulphur in the protein compounds, it forms sulphocyanogen. Wright has remarked the excretion of urea in the saliva during salivation. J. L. S.

22. *On the Digestion of Amylaceous and Saccharine Substances;* by M. Mialhe, (Comptes Rendus, March, 1846.)—The author has found that the saliva contains a principle identical with vegetable diastase. It is procured by treating the filtered saliva with 5 or 6 times its weight of absolute alcohol, which precipitates the substance in question in the form of white flakes, which can be collected on a filter and dried. It is readily preserved if kept in well stopped bottles. It does not act upon fibrine, albumen, gluten, or any of the azotized substances;—if heated with starch and water in a sand bath, to a temperature of from 158° to 175° Fahr., the starch is rendered soluble, it being converted into dextrine and glucose.

The saliva contains about $\frac{1}{500}$th of this principle, which the author seems to think exerts remarkable effects in the digestion of amylaceous substances;—as regards their assimilation, as well as that of saccharine substances, he is still of opinion that the alkalies of the blood exert considerable influence. J. L. S.

23. *On the Nourishing Quality of different Vegetable Substances, reckoned from the amount of Nitrogen contained in them;* by E. N. Horsford, of Albany, U. S., (Annal. der Chem. und Pharm., vol. lviii, p. 166.)—This is a very able research conducted in the laboratory of Prof. Liebig by the author, who appears to have devoted much time and care to the analyses. Besides simply estimating the amount of carbon, hydrogen, nitrogen, oxygen, sulphur, and ashes in the various vegetable substances that passed through his hands, the proportion of vegetable azotized substances contained in each one is also laid down; this is calculated from

the amount of nitrogen and the known composition of these principles as made out by Mülder, Scheerer and others.

The following is the statement of the nutritive value of some of the substances alluded to in the extensive table accompanying the memoir. Wheat is taken as the standard, and the numbers in the table represent how many parts of the corresponding vegetable are equal to 100 of wheat.

	Theory.		Experiments on animals by Boussingault.
	Dried at 212° F.	Fresh.	Fresh.
Wheat, ...	100·	100·	94·
Rye, ...	98·8	97·6	97·6
Corn, ...	115·	113·	108·
Rice, ...	220·	225·	
Buckwheat, . . .	170·	166·	122·7
Pease, ...	57·	60·	90·7
Lentil, ...	55·	58·	
Potato, ...	220·	596·3	429·
Yellow Beet, . . .	182·7	919·4	589.7

J. L. S.

24. *A Description of a new Mercurial Trough;* by Prof. Louyet, (Phil. Mag., May, 1846.)—It consists of a small oblong oak-box, $1\frac{3}{4}$ inches in depth, nine inches in length, and six inches in breadth. To the bottom is cemented a plate of glass exactly covering its whole extent; this glass has a small piece cut out of the middle of one of its shorter sides, either of a rectangular or V shape, extending about an inch and a half from the margin; the upper surface of the glass is ground perfectly level. The side of the box next to which comes the edge with the piece taken out, has a groove cut in it from the top to the bottom, terminating in an excavation in the bottom of the box; just over which the rectangular opening in the glass comes; so that a bent tube coming from a vessel in which gas is being generated, may have its lower extremity placed beneath the floor of the trough. The receivers used are tubulated, having the lower edges well ground. To fill the receivers, the lower edge is placed upon the bottom of the trough, it being previously greased if thought necessary, the stopper withdrawn, and then it is entirely filled with mercury and restopped. A small quantity of mercury is next poured into the box, so as to fill the small cavity, and cover the bottom for about the tenth of an inch; the receiver can now be moved in all directions, and placed over the cavity into which the extremity of the curved tube from which the gas is disengaged, is placed. The advantage of this species of trough is that with a small amount of mercury, large receivers may be used.

J. L. S.

II. Arts.

1. *Artificial Marble*, (Journ. de Chem. Med., April, 1846, p. 299.)—M. Bouisson has taken out a patent for preparing artificial marble from gypsum, which is to be cut of the required size, placed in a metallic trough in a furnace, and kept at the temperature of 90° for some time, after which a solution of alum in boiling water is poured upon it and a gentle heat continued for some length of time, the water being renewed as it evaporates. For a block six feet long and two feet in the other directions, exposure for five hours before the addition of alum solution, and seventy-two hours after, suffice to impregnate the plaster. The strength of the alum solution is one pound to six quarts of water. It is always well to cut the plaster in the form required before hardening it. By introducing coloring matter into the solution, various tints may be obtained. J. L. S.

2. *Preparation of a Substitute for Horn;* by M. Rochon, (Voigt. Mag. de Naturk. and Revue Scient., Feb., 1846, p. 256.)—In many of the arts, more especially where steel instruments are manufactured, glass windows are of great inconvenience owing to the frequent breakage by fragments of steel. The substitution of horn is attended with some inconvenience, principally on account of its want of transparency. A substitute is proposed to be made of very light cloth or wire gauze composed of fine brass wire, which is to be immersed repeatedly into a solution of isinglass until all the meshes are filled and a sufficient thickness acquired, after which it is covered with a coat of copal or other varnish to protect it from the weather. J. L. S.

3. *Amalgamation of Wrought Iron, Cast Iron and Steel, so as to prepare them for Fire Gilding*; by R. Boettger, (Poggend. Ann., 1846, No. 1, and Bib. Univer., March, 1846, p. 201.)—Place in a glazed earthen ware or porcelain vessel 12 parts by weight of mercury, 1 of zinc, 2 of sulphate of iron, 12 of water, and $1\frac{1}{2}$ of hydrochloric acid of 1·2 sp. grav.; then introduce the iron or steel into the mixture, which is to be heated to ebullition. In a little time the objects become covered with a thin coating of mercury; which enables us to apply immediately, the amalgam of gold that is used in the gilding. All that is now necessary, is to apply a strong heat which will drive off the mercury and the trace of zinc that may have attached itself to the iron, leaving a surface of pure gold. By the ordinary way, it becomes necessary to cover the iron first with a coat of copper. J. L. S.

III. Mineralogy and Geology.

1. *Oriental Jade and Tremolite*, by M. Damour, (Ann. de Ch. et de Phys. April, 1846; Phil. Mag. xxiii, 568.)—The jade selected for analysis had been worked in India; it was of a milk-white color and semi-transparent, and had the appearance of white wax, or perhaps rather spermaceti. Its fracture was splintery; it scratched glass, but feebly. Its specific gravity was found to be 2·970. Its tenacity was very great; when reduced to powder and heated in a glass tube, its appearance was not altered, and it yielded no water. In the flame of the blowpipe it swells up, and fuses slowly into a milk-white enamel. Borax dissolves it without color; the salt of phosphorus dissolves it, leaving a skeleton of silica. It is not sensibly acted upon by hydrochloric acid.

Two analyses gave the following results:—

Silica, ...	58·46	58·02
Lime, ...	12·06	11·82
Magnesia, ...	27·09	27·19
Protoxide of iron, . . .	1·15	1·12
	98·76	98·15

M. Damour having observed that this is precisely the composition of tremolite (white hornblende), submitted this substance to the same process of analysis as that adopted with the jade. The specimen which he selected was from St. Gothard, and in colorless crystals, very perfect and associated with granular dolomite, which was separated by hydrochloric acid previously to analysis.

It yielded—silica 58·07, lime 12·99, magnesia 24·46, protoxide of iron 1·82,=97·34.

From the similarity of these results, M. Damour is of opinion that this jade may be ranked with tremolite; and if this opinion should be adopted, he observes, that in collections oriental jade will hereafter be classed as *compact tremolite*.

2. *Substances in Guano;* by E. F. Teschemacher, (Phil. Mag. xxviii, 546, June, 1846.)—Mr. Teschemacher has detected the following substances in guano:—

Phosphate of Ammonia, occurring as a crystalline salt, perfectly transparent, with a brilliant cleavage in one direction. The quantity was too small for an analysis.

Bicarbonate of Ammonia, mixed with guano in its cavities as a crystalline salt, having brilliant cleavage in two directions. Measurement with the reflecting goniometer gave the angle of 112° between the adjacent planes. It proved on analysis to consist of ammonia 21·0, carbonic acid 55·50, water 23·50, =100, affording nearly the formula NH_3+2CO_2+2HO.

Ammonio-magnesian phosphate, imbedded in patches in the guano of Saldanha Bay on the coast of Africa. It occurs in distinct brilliant crystals, highly modified, having for its primary a right rhombic prism of 57° 30′ and 122° 30′, with rhombic cleavage. The specific gravity is 1·60 and hardness 2. It afforded on analysis, ammonia 14·30, magnesia 17·00, phosphoric acid 30·40, water 38·10, =99·80, giving nearly the formula NH_3MgO, PO_5+5HO. It is usually white and translucent, though sometimes discolored brown. Mr. Teschemacher proposes the name *guanite* for this species, it being the first occurrence of the compound as a native salt.

Besides these, there were detected in the guano of Saldanha Bay small globular particles consisting of concentric laminæ, which gave on analysis, carbonate of lime 37·50, carbonate of magnesia 32·00, phosphate of lime 12·00, water with a little ammonia and animal matter 12·00, sand 3·00, alkaline sulphates and chlorides 52·50, =99·50.

3. *Struvite*, (L'Institut, No. 644.)—Like the Guanite, this mineral, described by M. Ulex, is a phosphate of ammonia and magnesia; but it differs in containing 13 per cent. of water. The primary is a rhombic prism of 95° 10′; sp. gr. 1·7; hardness that of talc; slightly soluble in water. It was found on the site of an old church at Hamburg.

4. *Cryptolite;* by F. Wöhler, (Pogg. Ann., No. 3, 1846; Phil. Mag., xxix, 31, July, 1846.)—Cryptolite is a phosphate of the oxyd of cerium, found in the sea-green or reddish apatite of Arendal in Norway. It becomes apparent when the apatite is placed in large pieces in dilute nitric acid, appearing, as the apatite dissolves, in the form of fine crystalline needles of about a line in length. It occurred only in the reddish variety of apatite and constituted but 2 or 3 per cent. of the mass. It crystallizes in transparent apparently six-sided prisms of a very pale wine color; specific gravity 4·6. It undergoes no change at a moderate heat. It afforded on analysis peroxyd of cerium 73·70, protoxyd of iron 1·51, phosphoric acid 27·37, =102·58. The excess arises from the cerium having been determined as peroxyd instead of protoxyd, in which latter form it evidently exists in the mineral. The presence or absence of didymium and lanthanum remains undetermined.

It is probable that the apatite of Arendal contains another cerium mineral which is soluble, and it may possibly be monazite.

5. *On the Hematite in Connecticut;* by J. G. Percival, (Report on the Geology of Connecticut, p. 132.)—The rock which contains the Hematite iron ores in the northwest part of Connecticut and the adjoining part of New York, is a micaceous schist, the predominant variety of which has a light grey color, is sometimes more or less talcose, and often contains garnets and staurotides. Greenish (from chlorite) and

bluish varieties also occur, the latter highly pyritiferous and approaching argillite. The Hematite region includes within its limits the ore beds of Salisbury, Sharon and Dover; and traces may be observed more or less frequently throughout the formation from Patterson to Massachusetts. Mr. Percival goes on to observe:—"From the observations I have made, I have been led to believe, that the Hematite, like bog ore, is of secondary formation, and is derived from the decomposition of the pyrites, contained in the mica slate of the formation, particularly in the black sub-argillitic variety, and in a less degree, in the dark blue variety with transverse mica. Seams of Hematite may not unfrequently be observed in these varieties of the mica slate, which are besides characterized by their dark red brown rusted surface. The ore beds themselves present usually a distinctly stratified arrangement, in parallel beds interposed between the strata of the undecomposed mica slate adjoining, and quartz veins are also found in the ore beds, arranged precisely as they occur in the unaltered rock of this formation. The ore is accompanied with alternate layers of a yellow or reddish ochry earth, called fuller's earth by the miners, derived apparently from the decomposition of the light grey mica slate of the formation, which corresponds, in this respect, with the light grey mica slate of the preceding formation, as already observed. The different results, from the decomposition of the different varieties of mica slate, may perhaps depend on the peculiar composition of each, or on the fact, that magnetic pyrites abounds more particularly in the darker varieties, and common pyrites in the latter. The most important ore beds in Salisbury, namely, the Ore Hill, and Chatfield's, are situated on the east side of the depression south of Taconic Mountain; the others, in that town, along the east base of that mountain, farther north. Indian Pond ore bed, (Sharon,) is at the western base of the ridge next south of Taconic Mountain, towards its southern termination, and the Dover bed, on the eastern declivity of the present formation, west of Dover.

"This formation extends only a short distance along the west line of the state, namely, from west of Sharon village, to its northwest corner, being chiefly included within the limits of New York and Massachusetts."

6. *Subsidence of the Land at Puzzuoli*, (Jameson's Edinb. Jour., xl, 1846, 385.)—Mr. J. Smith stated to the British Association, that when he visited the temple of Jupiter Serapis at Puzzuoli, in March, 1819, its floor was elevated about 6 inches above the level of the sea; but on the 11th of May, in the year 1845, it was covered to the depth of 18 inches at low water, and 28½ at high tide,—the sea being calm at the time. The *custode* of the building told Mr. Smith that this change was progressive, amounting to 1¼ English inches per annum.

The cicerone, too, who had exercised his profession for thirty years, said, he knew a difference of at least 3 feet 6 inches in the height of the sea upon the piers of the Bridge of Caligula, giving the same amount of subsidence yearly. There were, besides, many similar proofs in the partly submerged houses and causeways of Puzzuoli. The perforations of the Pholades in the columns indicate a former period, during which the temple remained submerged at a stationary level; and contemporary accounts state, that, by an instantaneous movement, it was lifted to some height above the sea, which receded nearly 200 paces, leaving an immense quantity of fish, which were collected by the inhabitants. This took place in October, 1538, immediately before the elevation of Monte Nuovo.

7. *Notice of an Earthquake and a probable Subsidence of the Land in the district of Cutch, near the mouth of the Koree, or Eastern branch of the Indus, in June*, 1845. (Extracted from a letter to Capt. Nelson, R. E.—Journ. Geol. Soc. 1845, p. 103.)—"One of Capt. McMurdo's guides was traveling on foot to him from Bhooj. The day he reached Luckput there were shocks of an earthquake, which shook down part of the walls of the fort, and some lives were lost. At the same time as the shock, the sea rolled up the Koree (the eastern) mouth of the Indus, overflowing the country as far westward as the Goongra river (a distance of twenty English miles), northward as far as a little north of Veyre (forty miles from the mouth of the Koree), and eastward to the Sindree Lake. The guide was detained six days (from June 19th to 25th), during which time sixty-six shocks were counted. He then got across to Kotree, of which only a few small buildings on a bit of rising ground remain. Most of the habitations throughout the district must have been swept away, the best houses in Scinde being built of sun-dried bricks, and whole villages consisting only of huts made of a few crooked poles and reed mats. The guide travelled twenty miles through water on a camel, the water up to the beast's body. Of Lak nothing was above water but a Fakeer's pole (the flagstaff always erected by the tomb of some holy man); and of Veyre and other villages only the remains of a few houses were to be seen.

"There are said to be generally two earthquakes every year at Luckput. The Sindree Lake has of late years become a salt marsh."

8. *On the Vorticose Movement assumed to accompany Earthquakes;* by R. Mallet, (Phil. Mag. xxviii, 537, June, 1846.)—The phenomenon to which Mr. Mallet refers, is the apparent displacement and twisting of the stones of a column of masonry, as if produced by a partial revolution around a vertical axis. He shows that the supposition of an actual vorticose movement in the earth is not only improbable, but unnecessary to account for the facts: and farther that a simple horizontal

motion is sufficient, if the centre of adherence, in the stone to be moved, is not directly under the centre of gravity. This is proved by simple trial. With regard to the possibility of restoring of the stone to its original position by the backward move of an earthquake vibration, he argues that the forward and backward action are not equal, as the force producing the earthquake is usually progressive in one direction; and further, the new condition of the stone, after the first motion, renders it scarcely possible that the reverse motion, however, nearly the same, could exactly neutralize and return the stone to its former place.

The following are some instances of this peculiar motion mentioned as on record.

"The first notice I find recorded of such a peculiar motion, is in the Philosophical Transactions, in an account of the earthquake at Boston, in New England, of November 18th, 1755, communicated by John Hyde, Esq., F. R. S. He says, 'the trembling continued about two minutes; near one hundred chimneys were levelled with the roofs of the houses, and many more shattered. Some chimneys, though not thrown down, were dislocated or broken several feet from the top, and partly turned round as on a swivel. Some are shoved to one side horizontally, jutting over, and just nodding to fall,' &c. This author does not seem to have been struck with this odd circumstance of the twisting round of the chimneys, and offers no explanation. The next instance that I have found is in the account of the great earthquake of Calabria, in 1783, as recorded by the Royal Academy of Naples, quoted by Mr. Lyell, in his Principles of Geology, vol. i, page 482. After describing several other remarkable phenomena, tending to show the great velocity of the shock, such as that many large stones were found, as it were, shot out of their beds in the mortar of buildings, so as to leave a complete cast of themselves in the undisturbed mortar; while in other instances the mortar was ground to powder by the transit of the stone, he says, 'Two obelisks (of which he has given figures) placed at the extremities of a magnificent façade in the convent of St. Bruno, in a small town called Stephano del Bosco, were observed to have undergone a movement of a singular kind. The shock, which agitated the building, is described as having been horizontal and vorticose. The pedestal of each obelisk remained in its original place, but the separate stones above were turned partially round, and removed sometimes nine inches from their position without falling.'

"I have found some few other notices of similar phenomena in old books of travels. Two additional instances, however, will be sufficient. The first will be found in the quarterly journal of the Royal Institution, in a narrative of the earthquake in Chili, of November, 1822, communicated by F. Place, Esq.

"The church of La Morceda, at Valparaiso, built of burnt bricks, stood with its length north and south. [The houses are built of adobes, or sun-dried bricks.] 'The church tower, sixty feet high, was leveled; the two side walls, full of rents, were left standing, supporting part of the shattered roof, but the two end-walls were entirely demolished. On each side of the church were four massive buttresses, six feet square, of good brickwork; those on the western side were thrown down and broken to pieces, as were two on the eastern side. The other two were twisted off from the wall in a northeasterly direction, and left standing.' The direction of the shocks was thought to be either from the southwest, or from the northwest.

"The last instance I shall quote is from the pages of the able and delightful Darwin, in his Journal of a Naturalist's Voyage, (Colonial Library, edit. p. 308), in describing the effects of the great earthquake of March, 1835, upon the buildings in the town of Conception; and after noticing also the evidences of immense velocity in the shock, by which the projecting buttresses from the nave walls of the cathedral had been cut clean off close to the wall, by their own inertia, while the wall, which was in the line of shock, remained standing; he proceeds, —'Some square ornaments on the coping of these same walls were moved by the earthquake into a diagonal position. A similar circumstance was observed after an earthquake at Valparaiso, Calabria and other places, including some of the ancient Greek temples' (for which he quotes Arago, in *L'Institut*, 1829, p. 337, and Miers's Chile, vol. i, p. 392)."

9. *Geological Chart of M. Boué*, (Bull. de la Soc. Geol. de France, 2 Ser., i, 572.)—The fine large geological chart by Boué embraces a general view of the geology of the globe, and was published under the auspices of the Geological Society of France. The following results appear to be established by it:

1. The more ancient formations prevail towards the poles, in the principal ossature near the equator, and around the great ocean.

2. The intermediary (Silurian) formations exist about the poles and in the northern temperate zone. But they fail almost entirely under the equator.

3. The secondary formations rest in the concavities of the intermediary formations in the northern hemisphere, whilst they rest upon the primary of the equator.

4. The tertiary abound near the equator; they fill the lowest points of the basins of the sea, and form a zone extending from the Desert of Cobi, the country about the Caspian Sea, to the low plain in the north of Europe; whilst another similar zone extends from the northern part of the basin of the Euphrates, passes by Arabia and continues even to the Andes, and thence to the foot of the Himalaya towards the Ganges.

10. *Analysis af the Glassy Scoria of Kilauea, Hawaii*, (Proceed. Bost. Soc. Nat. Hist., July, 1846, p. 121.)—This glassy scoria including some of the capillary glass of the volcano, has been analyzed by Mr. J. Peabody in the laboratory of Dr. C. T. Jackson, with the following result: silica 50·00, protoxide of iron 28·72, lime 7·40, alumina 6·16, potash 6·00, soda 2·00, =100·28.

IV. Zoology.

1. *Description of two New Species of Fossil Echinodermata, from the Eocene of the United States*; by Samuel George Morton, M. D., (Proceed. Acad. Nat. Sci. Philad. iii, 51, May, 1846.)—*Cidaris Alabamensis.* Compressed, pentagonal, the angles rounded so as to form a ten sided figure. Ten rows of tubercles, with nine or ten in each row. Ambulacra arranged in five pairs, with delicate, slightly oblique fissures separated by a double elevated line. Surface between the tubercles and ambulacra finely granulated.

Galerites? Agassii. Elevated, hemispherical, with four pairs of ambulacra which diverge from the apex and meet at the margin, having each two rows of pores connected by transverse fissures. Surface marked by numerous, distinct granulations, which are continued over the whole base of the fossil.

I have much pleasure in dedicating this remarkable species to M. Louis Agassiz, whose profound researches into this class of organized beings, have thrown much new light on their structure, affinities and geological relations.

Both these fossils were found by Dr. Albert Koch, in the Eocene strata of Washington Co., Alabama, and by him politely submitted to me for description.

2. *Description of a New Species of Bat from Western Africa—Pteropus Haldemani;* by Edward Halowell, D. M., (Proceed. Acad. Nat. Sci. Philad., vol. iii, No. 3, p. 52, May, 1846.)—General expression ferocious; head resembling that of a dog; ears of moderate size, smooth for the most part, obtuse at the tip, hairy at base externally; there is no tragus; body dark brown above; neck, occiput and vertex same color, but lighter than upon the back; wings and interfemoral membrane of a sienna brown color above and below; thorax and upper part of abdomen and sides brown; the rest of the abdomen is white; there are two long and thin hairs upon the muzzle; lips full, nostrils prominent, their margins being surrounded by a fold of the skin; eyes rather large, irides ——; wings long; that portion of the membrane included between the phalanges naked, the remainder more or less hairy above and below: upper surface of the interfemoral membrane hairy, with the exception of a small part at its posterior extremity which is

naked; under surface also hairy, but much less so than upper; no tail; tibia and fibula included within the membranes; four slender toes, compressed, of nearly equal length, the outer one being a little shorter than the others; they are sparsely furnished with thin hairs, varying in length; the terminal phalanx of each is provided with a robust, sharp and incurvated nail. The index finger like the thumb is also furnished with a short and incurvated nail.

Measurements.	Inches.
Total length,	$3\frac{1}{2}$
Length of head,	$1\frac{3}{4}$
Distance between anterior margin of nostril and anterior canthus of eye,	$\frac{5}{8}\frac{1}{10}$
Distance between angle of mouth and anterior canthus of eye,	$\frac{3}{8}$
Length of neck, body and tail,	3
Length of forearm,	3
Length of tibia,	$1\frac{1}{4}$
Spread,	$14\frac{1}{4}$
Length of thumb,	$\frac{3}{4}$

Dental Formula.

Incisors.	Canines.	False Molars.	Molars.
2——2	1——1	1——1	2——2
2——2	1——1	2——2	3——3

This species I have named after my esteemed friend, S. S. Haldeman, Esq., author of the N. American Limniades, who obtained it with other African animals from Dr. Goheen, Physician to the American Colonization Socieiy.

3. *Description of Unio abacoides, a new species*; by S. S. Haldeman, (Proceed. Acad. Nat. Sci., Philad., iii, 75, June, 1846.)—Shell subovate, obtusely and regularly rounded posteriorly, disks approximate, chesnut brown and pale green, with green radiating interrupted capillary lines, and a tendency to form a submedial nodulous ridge: primary teeth robust, their inner margin nearly at right angles with the short lamellar teeth: pallial and muscular impressions well marked: nacre white, roseate posteriorly.

Length $2\frac{5}{8}$, height 2, diameter $1\frac{1}{8}$ inches.

Allied to U. dromas, *Lea*, and U. intermedius, *Conrad*, but is proportionally longer than either. In its outline and small transverse diameter it resembles U. abacus. I am indebted for this interesting shell to the liberality of Dr. Foreman, who received it from Eastern Tennessee.

4. *A New Species of Apus.—A. longicaudatus;* by John LeConte, F. L. S., (Ann. Lyc. Nat. Hist. N. Y., iv, 156.)—Pale brown: *buckler*

large, thin, gibbous, nearly round, carinate on the middle of the back, deeply emarginate behind, the edges of the emargination fringed with short spines: *eyes* three, simple, the two anterior larger, approximate, somewhat lunate, the third one round, placed in the middle behind the two others: *antennæ* very short, inserted near the mandibles, two-jointed, joints cylindrical, subequal, the second joints somewhat accuminate and naked at the tip: first pair of *feet*, or as they have been called, exterior antennæ, furnished with four articulated filaments; of these filaments, the outer one is longer than the body, the next half the length of the first, the third about one-third the length of the second, and the fourth very short: the other feet, amounting to ten pair, are flattened, trifid at the tip, the intermediate division being the longest, furnished on the inner side with a short branch, and externally with a broad lamina; below these feet are twelve pair of laminæ, the five anterior pair larger, the seven smaller pair reaching to the vent, which is covered by the last pair; these laminæ are complicated in their structure, and ciliate with short hairs: *tail* long, consisting of sixteen joints counting downwards from the vent, the last one the longest, somewhat coriaceous, emarginate and ending in two long articulated naked filaments; the joints of the tail and of the filaments are furnished each with a row of small spines, which run entirely round.

Length to the end of the tail, 1·5 of an inch—of the buckler, ·65—breadth of the same, 7.

Of the habits of this animal, we know but little; it was found in immense numbers in a small shallow lake on the high plateau between Lodge-pole creek and Crow creek, northeast of Long's peak, in the Rocky Mountains: they were swimming about with great activity, plunging to the bottom and rising to the surface. All of them that were caught appear to be males, at least none of them have any ova attached: the common species in Europe, A. cancriformis, on the contrary, has never been found but of the opposite sex.

5. *The Soft Bodies of Polythalamia found in a Fossil State.*—In a microscopical examination of chalk and flint by Dr. Mantell, published last August in the Annals of Natural History, it was announced for the first time, that the soft parts of foraminifera occur in a silicified state in the flints of the southeast of England. Dr. Mantell has followed up his researches, and has succeeded in obtaining the internal soft parts of rotaliæ, in the state of a dark brown carbonaceous substance, retaining the perfect form of the interior of the shell in which, when the animal was living, they were enclosed. This discovery was made by immersing chalk in weak hydrochloric acid, by which process not only the lime, but the calcareous shells the earth contained, were dissolved; the residuum being only grains of white and green transparent quartz, and

animal matter. This detritus was prepared for microscopical investigation by the usual process with Canada balsam; and several examples of the remains of the integumentary structure of rotalia were found, as perfect as insects in amber; even the *ova* remained in some examples; and in all, the connecting intestinal tube, with the little stomachs or sacs, the latter containing a brown granular substance, were preserved. Dr. Mantell has sent a communication on the subject to the Royal Society.

6. *Boring power of Land Snails on Limestone;* by W. C. Trevelyan, (Jameson's Edinb. Jour., xl, 1846, 396.)—Few persons are, I believe, aware of the fact, which I alluded to at the meeting of the British Association in Cambridge last year, on the occasion of a notice by Dr. Buckland, "On the agency of land snails in forming holes and trackways in compact limestone," that this phenomenon had been noticed many years ago by the late amiable and talented author of the History of Northumberland, the Rev. John Hodgson, an accurate observer of nature, who, in 1827, published in that work (part 2, vol. i, p. 193) the following passage:—"On a sunny bank near Whelpington, a stratum of limestone" (carboniferous) "is here and there seen in gray projecting masses, the *under* surface of which is bored upwards into cylindrical holes, which are from a line to four inches deep, and tenanted, especially in winter, by the banded and yellow varieties of the *Helix nemoralis*. The *limax*, while it occupies these cavities during summer, has its fleshy longitudinal disk protruded out of the shell, and coiled nearly into a circle on the surface of the stone, the summit of its shell hanging downwards; and in this position it probably elaborates its den in the same manner that some of the *pholades* work their way into clay and wood, or, by a slow but constant process, sink and enlarge their cells in the hardest stones." I had, sometime previously to the date of this publication, examined the spot, and was satisfied with the correctness of Mr. Hodgson's observations, and last October (1845) took advantage of an opportunity to revisit it, and was confirmed in the opinion I had before formed on the subject, and in the perfect accuracy of the description quoted above.

The thoroughly sheltered position of the *under* surface of the rock precludes the possibility of the holes being an effect of weathering; and I feel convinced that they are the result of the slow, but nearly constant action, of a weak acid secreted by the snails, which instinctively, for the sake of shelter, would resort to such a situation, and thus, in the course of ages, such holes would be formed in any substances on which the acid could act.

7. *On the Cause of the Circulation of the Blood;* by Dr. J. W. Draper, (Phil. Mag., March, 1846.)—In the memoir before us, the au-

thor gives a definite idea of how the capillaries and tissues operate in producing the circulation; that they are powerfully instrumental in this important function is now generally admitted; the circulation being considered due to a "series of vital attractions and repulsions not essentially different from those which are witnessed in physics and chemistry;" but we have never yet been informed what these attractions and repulsions are due to. It is on this point that Dr. Draper has thrown much light.

The physical principle upon which this new theory is based, is explained in the following manner.—If, in a vessel containing water, a tube of small diameter be placed, the water immediately rises to a certain point in the tube, and remains suspended. Let the tube be now broken off below that point, and replaced in the cup of water; the liquid rises as before, but though it reaches the broken extremity, it does not overflow. A capillary tube may raise water to its highest termination, but a continuous current cannot take place through it. If, however, the liquid at the top of the tube be allowed to evaporate, it will be replaced by that from the vessel, causing in this way a current through the tube; the same is true if the liquid be ignited, as in the case of an ordinary lamp, the wick of which draws the oil to the top, where it remains stationary until ignited, when it flows upwards through the wick until the lamp is emptied.

It is seen from these facts that ordinary capillary attraction can under certain circumstances determine the continuous flow of a liquid through a tube. But there is yet another circumstance under which this might happen, as where the attraction between the liquid and sides of the tube is greater at the point where they first come in contact, than farther up the tube.

Suppose a capillary tube composed of some substance having a strong attraction for oxygen, to be immersed in an oxydizing liquid, the liquid will enter the tube under strong attraction, but losing its oxygen the attraction diminishes as it passes into the tube, and if the attraction between the first portion of the tube and the liquid remains the same, this last will continue to enter and push forward that part that has lost its attraction for the sides of the tube. The above fact is expressed by the author in the following terms.—If a given liquid occupies a capillary tube, or a porous or parenchymatous structure, and has for that tube or structure at different points affinities which are constantly diminishing, movement will ensue in a direction from the point of greater to the point of less affinity.

This principle is applied to the *systemic circulation* in the following way. The arterial blood charged with oxygen, penetrates the various tissues by means of the capillaries, and as there is a strong attraction

between the tissues and oxygen, this last becomes absorbed, (producing the destruction of the tissues); this happening in the first part of the capillary system, and the blood behind being charged with the same gas, and the same attraction existing, the first portion after losing its oxygen and consequently its attraction for the sides of the vessel, is pushed onward by the arterial blood from behind responding to the attraction of the tissues, when it in turn loses its oxygen, and is pushed forward by another portion, thereby causing a continuous flow from the arterial to the venous system.

With the *pulmonary circulation* the reverse takes place—the venous blood passes onwards, pushing forward the arterial. Here the air cells of the lungs, along which the capillary system of the pulmonary vessel passes, contain oxygen, between which and the venous blood there is considerable attraction, but none between it and the arterial; so when the venous blood becomes charged with oxygen, it loses its attraction for the walls of the capillaries, and is pushed onward by venous blood not yet acted upon.

The *portal circulation* is explained in a similar way. Between the portal blood and the structure of the liver there is an energetic affinity, betrayed by the circumstance that a chemical decomposition takes place, and bile is separated; and that change completed, the residue, which is no longer acted upon, forms the venous blood of the hepatic veins, and is driven onwards by the affinities taking place between the portal blood and the substance of the liver. Another power which aids in forcing the blood from the portal into the hepatic veins, is the passage of the blood from the hepatic arteries into the portal veins, which is brought about by the cause alluded to in speaking of the systemic circulation.

The author also alludes to the *fœtal circulation* in the placenta, which is similar to the pulmonary circulation,—deoxydized passing onward toward oxydized blood. The umbilical arteries carry in their spiral courses, as they twist round the umbilical vein, the effete blood of the fœtus, and distribute it by their ramifications to the placenta. In that organ it is brought into relation with the arterial blood of the mother, which oxydizes it, becoming by that act deoxydized itself. The fœtal blood now returns along the ramifications of the umbilical vein, and finally is discharged from the placenta by a single trunk.

The application of the principle here set forth, furnishes a very felicitous explanation of a great number of effects which we witness. It is well known that after ordinary death, whilst the arteries are empty, the systemic veins and also the right cavities of the heart are full of venous blood. The reason is clear, although the ordinary theory, that the heart acts like a pumping machine, fails as is well known to explain

it. As long as arterial blood is deoxydizing, it will move to the venous side, a movement which must continue until the arteries are empty.

In the same way, in fainting, the blood leaving the arteries, accumulates on the venous side, and as its flow is dependent on the push of the arterial blood entering the capillaries, so soon as no more enters, no pressure is exerted in the venous trunks, and if a vein be opened there is no discharge, and under such circumstances hemorrhages at once cease.

Dr. Draper in the same memoir offers some new views concerning the coagulation of blood, which are highly important, but as yet are not fully established. J. L. S.

V. Botany.

1. *Sigillaria and Stigmaria.*—Several new examples of the occurrence of Stigmariæ as the roots of the trees termed Sigillariæ, have been brought before the Geological Society of London. Mr. Binney describes an upright trunk of a Sigillaria with Stigmaria roots fifteen feet long, spreading out into the surrounding clay; the top of the trunk terminated in the coal above the bed of clay. It was found in the coal at Dunkinfield, in about the same geological position as the one described in Dr. Mantell's Medals of Creation, at St. Helen's; from which locality it is about twenty-five miles distant. In the Sydney coal-field, at Cape Breton, Mr. Brown describes several, and states that upright trees with roots (Stigmariæ) may be seen in the cliffs near Sydney harbor. It is to be hoped that a specimen will be dug out with the roots and stems in conjunction, and placed in some public museum, so as to satisfy the most sceptical; for many eminent geologists still doubt the accuracy of the above inferences.

2. *The relations of Noggerathia with living Plants.*—The memoir on this subject, read by Ad. Brongniart before the French Institute on the 29th of December, is inserted in the *Ann. Sci. Nat.* for January last. The plants referred to this genus appear to have contributed largely to the formation of coal. As the result of a very acute investigation, M. Brongniart removes this genus from the Palms, and confidently refers it to the Cycadaceæ. The memoir closes with the following interesting remark. "This genus being excluded from the class of Monocotyledons, the *Flabellaria borassifolia* of Sternberg being also removed from the family of Palms to the Gymnospermous division, and the genus Artisia being in the same case, there only remain in certain ancient formations, such vague indications of the presence of the great Monocotyledonous division of the vegetable kingdom, as are furnished by several fruits, the structure of which is too imperfectly known to warrant their being referred with any probability to

that natural division, so long as no known stems or leaves can be referred there. Thus, the conclusion to which all researches up to the present time seem to lead is, that the terrestrial vegetation of the coal-epoch was limited to two great divisions of the vegetable kingdom, viz. the Acrogenous or Vascular Cryptogams, and the Gymnospermous Dicotyledons. A. Gr.

3. *Structure of the Trunk of Cycas circinalis*, (Ann. Sci. Nat., Jan. 1846.)—From the examination of some old trunks of Cycas received from Java, Prof. Miguel draws the following conclusions.—1. The stem of Cycas is composed of two sorts of elementary organs, viz. *parenchymatous cells* and *dotted vessels*, agreeing in this respect with the structure of Coniferæ. 2. In the distribution of these elementary organs, it differs greatly from that of Coniferæ: the wood is disposed in irregular concentric layers, confluent at certain points, unequal, having no relation with the buds, separated by broad layers of cellular parenchyma. 3. In the development of the tissues there are several peculiarities which are not found in Coniferæ; for instance, in the increase of the trunk in length from the summit only, in the preponderance of parenchymatous cells, in the ligneous parts being traversed by cortical parenchyma, &c. 4. In this acrogenous growth and by the clefts in the woody layers, there is a distant resemblance with the trunk of Ferns; but the continuous peripheric growth is a complete distinction. 5. The structure of the trunk of Cycas, in all its peculiarities, more nearly resembles certain vegetables of a former epoch, than of the present. The author then compares the trunk of Cycas with that of Zamia and Eucephalastos, which have a single woody cylinder, with or without medullary rays. A. Gr.

VI. Astronomy.

1. *Fifth Comet of* 1846.—The comet discovered May 19, 1846, by Mr. George P. Bond, of Cambridge, Mass., and the elements of which were published at p. 138, had been previously detected (on the 2d of that month) by the sharp-sighted astronomers of the observatory at Rome. Mr. B. was, however, the *discoverer*, so far as America is concerned, both of this comet and also of that whose elements are given at p. 447 of vol. i, 2d Ser.; and is entitled to none the less credit, because anticipated by one of the large corps of European observers.

2. *Antares, a triple star.*—Prof. Mitchel of the Cincinnati observatory, found in June, 1845, that Antares is accompanied by a minute star distant only 1·7″. In a communication dated July 30, 1846, in the *Union*, Lieut. M. F. Maury, of the Washington observatory, announces the discovery just made there, that this star has a second companion, and is of course a *triple* star. The principal star is *red;* the companion discovered at Cincinnati is *blue;* the second companion is *green.*

3. *Supposed New Planet*, (L'Institut, No. 648, June, 1846.)—At a session of the French Academy of Sciences, June 1, 1846, M. Leverrier read a memoir in which he states that after a full discussion of the subject, he is satisfied that it is impossible to represent the motions of the planet Uranus, except by supposing the existence of another planet beyond Uranus, and at twice its mean distance. The heliocentric longitude of this new planet, January 1, 1847, he gives at 325°, a place which he thinks will not be in error ten degrees.

VII. Miscellaneous Intelligence.

1. *The Potato Disease.*—As the season approaches when the ravages of this disease generally make their appearance, it is desirable to know how far investigations already entered into, have proceeded towards the detection of the cause of such an evil, and the suggestion of a remedy. Little has as yet been done on any organized plan in this country. In Europe the case has been very different. In Holland and Belgium a committee was first appointed to collect facts calculated to throw light on the nature of the disease. In one of the Dutch provinces, Groningen, a separate commission was appointed for the same purpose.

In Germany, Liebig among others has turned his attention to the potato, and has lately published some observations on its nitrogenous constituents.

A number of the French philosophers, both alone, and under the auspices of the Central Society of Agriculture, have also attended to the subject. M. Payen has lately published three or four reports containing the results of elaborate microscopic and chemical researches.

The English government sent a commission to Ireland, of three distinguished scientific men, with directions to obtain as much information as possible on the nature and extent of the disease. In Scotland originated the most extended scheme of all. The subject was taken up in its several branches as it is connected with botany, meteorology, entomology, and chemistry. Each branch was referred to a competent person, and the investigation is still in progress.

It is not as yet even certainly determined in what form the disease first attacks the plant. A great number of observers have considered that it is first seen in patches of dark colored fungi on the leaves, thence gradually spreading down to the tubers. Dr. Ferguson in Paris, and several others in England, think that they have detected the sporules of the fungus passing down through the stem in the ordinary circulation of sap. But there are well authenticated instances where the potato tops have remained green and flourishing while the tubers were much diseased; it cannot therefore be said with certainty that the disease first appears as a fungus on the leaves.

All agree that the nitrogenous compounds in the tuber are affected first, and to a peculiar state of these constituents, Liebig and others have referred the origin of the disease. The starch is attacked last, and often remains uninjured when the walls of the cellular tissue that enclose its globules are nearly destroyed. From potatoes which have become even offensive in their smell, perfectly good starch has been extracted. The manufacture of starch becomes of great importance in the economical disposition of the diseased potato.

The report of the Groningen commission ascribes the disease to the wetness and sudden changes of the two last years. M. Payen thinks that excessive moisture has predisposed the potato to yield to the attacks of fungi. Mr. Phillips of London has published a pamphlet in which he ascribes the whole thing to the same cause. These are only a few of those who advocate this view of the question. All who have experienced much rain, assign this as the cause of disease, not knowing that it has been quite as bad on dry soils and where there has been little rain. In all the west of Scotland the summer of 1845 was considered rather a dry one, and in Islay, one of the Western Islands on the Scotch coast, the streams had not been so low for many years. The potatoes were as much affected in this part of Scotland as on the east coast. These facts seem quite decisive on the subject of wetness, for one well authenticated case where the disease has occurred under circumstances that preclude the idea of its being caused by wet, renders the theory quite untenable.

It is not so easy to decide whether atmospheric influence is the cause of the disease. In order to arrive at any certain conclusion on this point, extended meteorological observations are necessary. It is a singular fact that three or four counties forming the extreme northern point of Scotland were entirely free from it; without any essential difference in their season from that of the other counties, so far as was known by ordinary observers. The overseer of Mr. Fleming of Barochan, in Renfrewshire, Scotland, lifted from one of his fields on the 5th of September last (1845) about 5 cwt. of potatoes; these were stored in the house and remained perfectly sound at the date of his writing, in the middle of winter. From the same field on the 15th of September were lifted 5 cwt. more of the same potatoes. These after being in the house two days, were tainted and decaying, as was the case before the end of September with all that were left in the field. In this instance the crisis in the change from the healthy to the diseased tuber took place between the 5th and 15th of September. If the disease had shown itself at this time simultaneously in every part of that district, this fact would go far to show that it was caused by some atmospheric influence; but the contrary was the case. In some fields it appeared as early as

July, even on adjoining farms. The cause then remains still a mystery.

Of remedies a very great number have been suggested; many without due consideration.

The commissioners sent by the English government into Ireland were particularly unfortunate in this respect, for want of a little practical knowledge added to their undoubted scientific attainments. All the means of prevention that have formerly proved successful failed during the last year. An excellent method has been to change the seed every year, taking it from a high country to the lowlands, but this was found to have lost its efficacy. Gypsum, and hot slaked lime, have also been of little benefit. The *greening* of potatoes intended for seed, by letting them lay in the sun, has been much recommended, and on cutting up the sun burned potatoes it has been found, according to some statements, that the greened parts were never diseased. It may be well to turn attention to this subject. In former years some persons succeeded in invigorating the crop by means of certain saline manures, and even during the last season it was thought that they were in some degree beneficial. We are not aware that any plan heretofore suggested has proved uniformly successful over any great breadth of country.

The preservation of the crop during the winter has excited the deepest interest, and here also the number of methods proposed defies enumeration. The result of all the trials seems to be that the disease makes very slow progress and in many instances none at all, when the potatoes are kept *perfectly dry* and *well ventilated*. Both of these conditions seem absolutely essential; packing them in dry absorbent earth, and even in charcoal has proved a signal failure. It is necessary in any case where the disease has made much progress to pick over the heaps frequently, and carefully select all of the affected tubers. Kiln drying has been resorted to in cases of extremity; this preserves the potato for food but of course destroys its vitality.

Of the various plans proposed for the planting of potatoes in spring, none has been found more efficacious than cutting carefully selected potatoes into sets, containing each two or three healthy eyes. These setts are sprinkled with sulphuric or hydrochloric acid, diluted in the proportion of one pound of acid to four gallons of water. Newly slaked lime, or gypsum is then added so as to form a crust over the cut surface.

The diseased potatoes have not been found injurious as food. In Scotland all kinds of domestic animals have been fed with them freely, and actually thrived upon them. We have in the present communication glanced merely at the principal points of interest hitherto touched, in the researches upon this subject; it is much to know which are false theories, even if we have made little positive advance.

Prof. Johnston in a late communication has informed us that from attentive consideration of the analyses of diseased and healthy potatoes made in his laboratory during the past year, he has been led to recommend the application of a certain manure to the potato crop, as calculated, in many cases if not universally, to arrest the disease. He does not speak of this with confidence, but as a thing yet to be tried. The publication containing his paper has not yet reached us and we are consequently unable to say more.

We are forced to conclude that the origin and causes of this disease are at present unknown; its mysterious marks have appeared suddenly on two continents, separated by wide oceans; under heat and drought, rain and cold, on wet and dry, light and heavy soils, at every elevation, and in every variety of potato. Those who have most carefully investigated its peculiarities, most widely examined its range, are most undecided as to its cause.

Only by a very long and extended series of experiments, by an accumulation of accurate results, can we hope to arrive at a solution of this mysterious problem. No subject of the present day offers more attractions to the scientific man, or a wider field of usefulness. The very existence of a crop of incalculable importance seems at stake; practice has entirely failed in its efforts to correct the evil, and looks to science for that aid, which, if within the limits of possibility, should be afforded. J. P. N.

2. *Paper from the banana.*—M. Rogue has proposed in a late communication, the manufacture of paper from the fibres of the banana, and trials by a committee succeeded in producing a white and good paper. M. Rogue intends to carry on this operation in Algeria, not merely from the banana, but also from the aloes and other textile plants; and it is said that a large grant of land has been made to him in the Colony for that purpose.

3. *On the Mounds and Relics of the Ancient Nations of America.*—(The following is an extract of a letter from the senior editor to Dr. G. A. Mantell, London.)—At a special meeting of the Connecticut Academy of Arts and Sciences, July 7, 1846, various interesting facts relating to the mounds of the Ohio and Scioto valley, and specimens from them, illustrating their objects and the habits of their builders, were laid before the Academy, by Mr. E. Geo. Squier. These structures of the west are either enclosures, some evidently intended as fortifications, or mounds of various forms and sizes. This gentleman, in connection with Dr. Davis, of Chillicothe, Ohio, has opened eighty of the mounds, and has attended personally at the excavation of more than sixty. The developments are wonderful, and our explorer has satisfied himself that of the mounds, 1st. Many are sepulchral; 2d. Others sacrificial; 3d. Others for lookouts and alarm posts.

In the sepulchral, are found human bones, generally much decayed, so that no skeletons and rarely a perfect bone can be extricated—so ancient are they; and often the mounds of all descriptions are covered by gigantic forest trees. In one instance a section of a tree gave 600 annual rings. The sacrificial mounds cover altars sometimes of large size and constructed of baked earth hardened like bricks or tiles, and more rarely of stone. These altars contain calcined human bones, charcoal, and other proofs of the operation of fire. The merely sepulchral piles are earth mounds thrown up at random without arrangement of the materials; those covering altars were artificially stratified—layer over layer of alternating beds of gravel, earth and sand, but following a common curvature, like a series of caps drawn over the same head; this stratification, when heretofore named but not fully and accurately reported, induced Prof. Hitchcock to suppose that the mounds were diluvial; but their form and the interred altars with their relics disprove that opinion, although we know not why the altars were covered with so much care, or why covered at all: probably the proceeding was interwoven with their religious notions. In both kinds of mounds, but more especially in the mounds of sacrifice, are found very remarkable works of art wrought in stone. Among them were images of many of the animals and birds of that period; they were often wrought into pipes of various fanciful shapes; an otter with a fish in its mouth; a hawk tearing a bird to pieces; owls, eagles, bears, &c., and many human heads and faces, giving doubtless the craniology and physiognomy of the people—besides many things not exactly obvious as to their import. There are many stone arrow and spear-heads beautifully chipped out of hornstone of various colors, or formed from obsidian, or limpid quartz; and among the relics are much white mica in flakes, vessels of pottery, and pipestone similar to that of Prairie du Chien described in the American Journal, Vol. xxxviii, p. 140. The minerals grouped in these mounds came often from remote regions, and thus furnish proof of extensive migrations, or friendly or warlike travelling or commerce. There are strings of beads of ivory, (probably from the mastodon or *Elephas primigenius*, which were cotemporary in this country,) strings also of pearls—doubtless from the fresh water molluscs, and possibly from the Gulf of Mexico; and there were also fossil teeth of sharks, and other teeth probably cetacean. Besides, there are chisels and axes of native copper, and articles of silver. [The copper doubtless came from Lake Superior, where it is now found abundantly, and at this moment thousands are exploring there for it on both the American and British side of the lake. The great mass weighing from three to four thousand pounds, (see Amer. Jour., iii, 204,) now lies in the court-yard of the War

Office at Washington, and a piece weighing 1630 pounds is almost in view from the window at which I am writing, in the door-yard of my friend Mr. Forrest Shepard, an active geological explorer; both these grand pieces with native silver adhering to them, are from the Lake Superior Copper Region.]

The telegraphic mounds (No. 3) extended in ranges at convenient distances for many leagues; so that fires kindled upon them would give early and effectual notice of the approach of an enemy, as I remember to have seen in England, in August, 1805, when Napoleon's invasion was expected.

The enclosures serving as regular works for defense, were furnished with parapets, ditches, towers at the angles, and covered ways especially to supplies of water near rivers. These works appear, often, to have included a dense population in villages; and it is obvious that the hundreds of earth structures found in the valley of the Scioto, and the thousands, many thousands, in Ohio and other states, (not a few of which I have seen in Ohio, Illinois and Missouri,) necessarily implied a considerable population: and of course it was agricultural, at least in part, as they could not in such numbers subsist upon the chase alone; and there must have been an energetic government to coerce, or powerful mental influence to induce, so much labor. The present Indians do not submit to such toils, and have only very humble arts. They have however often buried their dead in the ancient mounds; but it is easy to distinguish these more modern deposits.

The ancient mounds were always erected in plains and valleys of fertile land, and on alluvial river deposits; and in some cases there are river terraces at lower elevations than those on which the mounds are found, thus perhaps indicating their high antiquity.

These explorations by Messrs. Squier and Davis differ from all preceding ones, not only by their number, but by the thorough manner in which the researches are made, an entire section of the mound having been cut from top to bottom, thus disclosing its contents. They have at Chillicothe, six thousand specimens which have been taken from the mounds, a selection of which will be made, to illustrate a work on this branch of archæology which is now in the course of preparation.

Mr. Squier has presented his subject in some of the principal northern cities of the U. S., where it has excited much interest; and both a learned individual and a learned society have volunteered the sums requisite for its publication. The races that constructed these works were probably the precursors of the Mexicans and Peruvians, and may have either deserted their structures to move farther south, or been driven from them by war.

The mounds resembling animals in form, which were described by Mr. R. C. Taylor, (Amer. Jour. xxxiv, 88,) and again by Mr. S. Taylor, (ibid., xli, 21,) are regarded by the gentlemen of whose labors I have given you a sketch, as more modern structures, perhaps even of the present races of Indians, but this is by no means certain.

4. *Pipestone of the Ancient Pipes in the Indian Mounds*; by E. G. Squier.—With respect to the stone of which these pipes were made, some light appears to be thrown upon the locality where it was probably obtained, by Du Pratz, p. 179. The description could not possibly be more exact. As the book may not be at hand, I transcribe the passage.

"In this journey of M. de Bourgmont, mention is only made of what we meet with from Fort Orleans, from which we set out, in order to go to the Padoncas; wherefore I ought to speak of a thing curious enough to be related, and which is found on the banks of the Missouri; and that is a pretty high cliff, upright from the water. From the middle of the cliff juts out a mass of *red stone with white spots, like porphyry*, with this difference, that what we are speaking of is almost soft and tender like sandstone. It is covered with another sort of stone, of no value; the bottom is an earth like that on other rising grounds. The stone is easily worked, and bears the most violent fire. The Indians of the country have contrived to strike off pieces thereof with their arrows, and after they fall in the water plunge in for them. When they can procure pieces thereof large enough to make pipes, they fashion them with knives and awls. This pipe has a socket two or three inches long, and on the opposite side the figure of a hatchet; in the middle of all is the bort or bowl of the pipe to put tobacco in."

The cliff occurs it seems on the banks of the Missouri. The quarries of the *Coteau des Prairies* are at a long distance from the river. Further, the *white spots* mentioned, *speckling*, if I may use the term, the stone, do not occur in the pipestone of the prairie—at any rate in none of the specimens I have seen. And these white spots constitute one of the marked features in the stone of the mound pipes.

5. *Discoidal Stones;* by E. G. Squier.—I may add to the remarks in my paper on the Discoidal Stones, (p. 216,) that Du Pratz, p. 366, describes the game mentioned by Adair, fully explaining the purpose of the oblique-edged stones, figs. 1 and 5 of Dr. Morton. These when rolled would describe a convolute figure. Says Du Pratz—

"The warriors practise a diversion which is called the game of *the pole*, at which only two play at a time. Each has a pole about eight feet long, resembling a Roman f, and the game consists in rolling a flat round stone, about three inches diameter and an inch thick, *with the edge somewhat sloping*, and throwing the pole in such a manner that

when the stone rests, the pole may touch it or be near it. Both antagonists throw their poles at the same time, and he whose pole is nearest the stone counts one, and has the right of rolling the stone."—*Du Pratz, p.* 366.

Mr. Brackenridge (Views of Louisiana, p. 256,) mentions a game popular among the Arikara, (Riccarees,) played with a *ring*, fig. 4 of Dr. Morton.

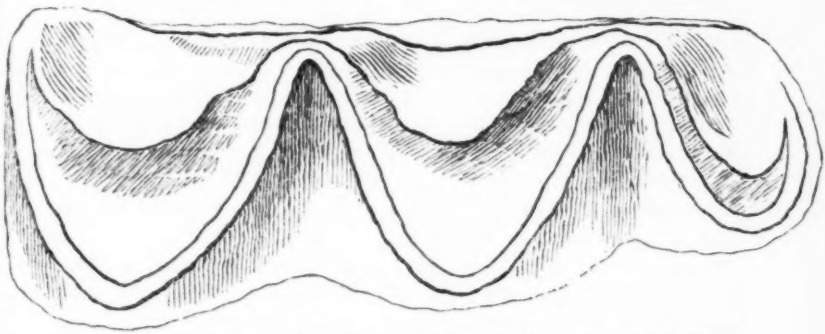
Lewis and Clark also describe a game, common among the Mandans, resembling the one above mentioned, which was played with stones of this description.

The two discoidal stones which were found by Mr. Chas. W. Atwater, in a mound near Huron, and mentioned by Dr. Morton, are unquestionably modern in their origin, as are also the other articles discovered by him; the human remains being those of the modern Indians—modern as compared with the great race of mound builders. It is a well known fact that the present race of Indians did, and to the west of the Mississippi still frequently do, bury their dead in the mounds, in conformity with the almost universal custom which leads them to select bluff points and the brows of hills for their burying places. It is therefore all important, in examining the mounds, that a proper discrimination should be made between the various deposits. The lack of it has already led to many errors and some amusing blunders. It may, I think, be laid down as an unvarying rule, that whatever human remains and deposits made with them, are found within two, or even four or five feet of the surface of the mounds, are those of the more recent races of the aborigines.

6. *Gigantic Palæotherium.*—We have recently received information from Mr. H. A. Prout, of his discovery of the remains of a Palæotherium in the tertiary near St. Louis, and we are also indebted to him for a cast of the jaw, a view of the posterior tooth of which is represented below. Mr. Prout is preparing a memoir on the subject; and in the mean time we state the following facts from his letter.

This fossil was found in the great northwestern tertiary belt, which is deflected from the north by the Black Hills, and which crosses the Missouri River at about latitude 43°. It was accompanied by several Baculites compressus, an Inoceramus concentricus, a vertebra of a large fish and some crystallized gypsum. The entire jaw bone, judging from the decrease in the size of the teeth, must have been at least 30 inches long, which far exceeds in size the Palæotherium magnum. The face of the posterior tooth, is $4\frac{2}{3}$ inches in length; and from the posterior side of the last tooth to the anterior side of the antepenultimate molar of the same side, the distance in the specimen is 11 inches. This is the aggregate length, in the line of the jaw, of but *three* out of

seven teeth; and with the most liberal allowance for decrease of size in the other four, the whole of the seven could not have measured less than 16 or 18 inches, which is about one half larger than in the P. magnum.



Vertical view of the posterior tooth, belonging to the lower jaw of Mr. Prout's Palæotherium—natural size.

7. *Relative Quantities of Land and Water on the Surface of the Earth;* by Prof. S. P. RIGAUD, (Trans. Camb. Phil. Soc., vi, 289, 1837.) Prof. Rigaud obtained his results by cutting up the map paper of a three feet globe (one of Mr. Addison's), separating thus the land from the water, and weighing each parcel. Every precaution was taken to ensure accuracy, and full confidence may be placed, it is believed, in his results, excepting of course such errors as necessarily arise from ignorance of regions yet unexplored by man.

This mode of determining the proportion of land and water was used by Dr. Halley in 1693; and afterwards for the whole globe by Dr. Long, as published in his Astronomy, (1742,) Art. 580.

The following are some of the results arrived at by him. The sphere is supposed to be divided into 1000 parts, and out of them the ratio of land to water in the—

	Land.	Water.			
Whole sphere, . . .	265·9233	734·0762	or	100 :	276*
Northern hemisphere, .	197·2153	302·7846	"	100 :	154
Southern hemisphere, .	68·7080	431·2916	"	100 :	628
Torrid zone, . . .	98·7171	300·0318	"	100 :	304
North polar circle, . .	18·0263	23·4437	"	100 :	139
North temperate zone, .	126·6308	132·5247	"	100 :	105

* The late discoveries in the Antarctic region will require a correction of the ratio here given for the whole sphere. Dr. Long obtained for this ratio, omitting the polar circles, the ratio of 100 to 281.

	Land.	Water.		
North half of torrid zone, .	52·5582	146·8162	" 100 :	279
South half of torrid zone, .	46·1592	153·2156	" 100 :	332
South temperate zone, .	22·5488	236·6060	" 100 :	1049

Land.	N. Polar.	N. Temp.	N. Torrid.	S. Torrid.	S. Temp.	Total.
Europe, . .	0·9524	15·6989	———	———	———	16·6513
Asia and islands,	5·0329	65·5901	13·6039	3·9743	0·5308	88·7320
Africa, . .	———	10·2760	29·7231	15·7697	3·8076	59·5764
New Holland, .	———	———	———	6·0263	9·7063	15·7326
North America, .	12·0410	35.0658	3·4857	———	———	50·5925
South America, .	———	———	5·7455	20·3889	8·5041	34·6385

The waters of rivers and lakes were taken into account as well as those of the oceans.

8. *Eruption of Mt. Hekla*, (Lond. Atheneum.)—An eruption of Mt. Hekla commenced September 2, 1845, and continued with unabated fury, until the 2d April of the present year. There is no example of such a prolonged phenomenon in the annals of Iceland. Very singular consequences have ensued. The winds have carried the volcanic ashes all over the island, and the cattle are perishing, poisoned by the herbage which it taints and covers. The poison developes itself in singular forms of disease, and it is thought that if the eruption continued two months longer, all the cattle in the island must be destroyed, or abandoned to death by this strange malady. The eruption is described in fearful characters. The flames from each of the three craters were thrown up to a height of 2400 fathoms, and their width exceeded that of the greatest river in the island. The lava lay mountains high: and masses of pumice-stone weighing half a ton, had been carried a distance of a league and a half. The ice and snow of centuries, had all melted in the heat, and overflowed the rivers: and the Rangen, swelled also by the burning lava, left its finny tenants on its shores dead and cooked.

The Royal Academy of Sciences, at Göttingen petitioned the King of Hanover to send commissioners into Iceland, at the Government expense, for the purpose of observing this phenomenon; and two distinguished Geologists, Mess. Berez and Sartorius were nominated for that duty.

Since the eruption of the volcano has ceased, the whole southern portion of Iceland has been disturbed by frequent earthquakes.

9. *Vesuvius;* (Athenæum, July 18, 1846.)—Letters from Naples announce that Vesuvius is in full eruption, throwing out masses of lava and making the night magnificent with its spectacle.

10. *Australia.*—The late voyage of the Beagle under Commander J. L. Stokes, R. N., has resulted in the discovery of five rivers on the north coast, named the Fitz Roy, Victoria, Adelaide, Albert, and Flin-

ders. Victoria was much the largest, and its course was examined for 140 miles. The natives discovered on the banks are represented as fine, bold men, contrasting strikingly with the "miserable objects" seen at Sidney. The Albert and Flinders empty into Gulf Carpentaria. The former runs through a country of great beauty, the best seen in northern Australia. The farthest point reached was named the Plains of Promise, from the conviction that future explorers of the interior of this continent, must here take their departure. Capt. Stokes feels assured that with camels and little expense, the exploration would be easily effected.—*Discoveries in Australia, during a voyage of H. M. S. Beagle, under J. L. Stokes, Commander*, 2 *vols.*—Athenæum, June 27, 1846.

In South Australia valuable copper mines have lately been opened. The first was discovered at Kapunda in 1842, and to the close of 1845, no less than 1200 tons of ore had been sent to England. The ore is principally the sulphurets and carbonates of copper. The Montacute mine was opened in 1844, and is considered very promising. Still another mine of great extent has been since found in the vicinity of Razorback Mountain about 100 miles north of Adelaide.

11. *Mount Ararat;* (L'Institut, No. 649.)—M. Abich, who has lately been engaged in a scientific journey over Asia Minor, has discovered in the vicinity of Mt. Ararat, rocks of the era before the coal, and to the southeast of the valley of the Araxes, where in the middle of the river stands the island of rocks of Corvirab, he has detected *Sprifers*, *Terebratulas*, a *Productus* and *Crinoidea*. Hardly 20 versts from Ararat he collected the *Cyathophyllum flexuosum;* and not far distant, in the Daralagian Mountains, perpendicular beds filled with Productus, Orthis, and Crinoidea occurred surrounded by Jurassic beds containing small Exogyri. M. Abich will return to Ararat by the Mountains of Maku to complete his chart of the region.

12. *Museum of Natural History at Paris;* (Athen., July 11, 1846.)—The Chamber of Deputies has voted a sum of 136,786 francs for the acquisition of ground wanted for the purposes of the Museum of Natural History.

13. *M. Jacobi.*—This distinguished geometrician of Berlin has been elected to fill the vacancy in the list of foreign members of the Academy of Sciences at Paris, occasioned by the death of M. Bessel. The other candidates were MM. Brewster, Buckland, Herschel, Liebig, Melloni, Mitscherlich, and Tiedemann.

14. *Lavoisier*, (Athen. July 18, 1846.)—The founder of Chemistry, Lavoisier, was, as our readers know, snatched away by a violent and premature death, ere he had found time to collect and arrange his works. In 1843, the Minister of Public Instruction consulted the Acad-

emy of Sciences as to what works of that philosopher should be included in a national publication; and a committee was appointed to examine, and report on the matter. This committee has now made its report; and recommends that the Chamber of Deputies be asked for a sum of from 40,000 to 60,000 francs for the purposes of the publication according to its suggestions. It is only with the view of giving a national character to this edition of Lavoisier, as the Committee observe, that they apply to the State for its cost; for a member of the illustrious chemist's own family would gladly take upon himself the entire expense, and renounces his right to do so only because of the greater glory redounding to Lavoisier from the sponsorship of the Government.

15. *Leibnitz*, (Athen. July 18, 1846.)—The honors paid to the memory of Leibnitz, on the occasion of the two-hundredth anniversary of his birth, have not been confined to his native town, Leipsic. In that city, however, we must not omit to mention, the King of Saxony contributed to the celebrations the important one of the creation of a Royal Academy of Sciences. It is divided into two classes; the first including Natural Philosophy and the Mathematics—the second, History and Philology. Each class is to have twenty-five national members—residing either in the kingdom of Saxony or in the Saxon countries of the Ernestine line,—and a certain number of foreign associates and corresponding members. On the first occasion, the native members are, as in the Vienna Institution, to be named by the King—but after-vacancies will be filled up, in each class, by its own election. The Academy is to hold two public meetings yearly—one on the King's birthday, the other on that of Leibnitz. When these come too close together, the second public sitting is to be held on the 14th day of November, the anniversary of the philosopher's death.—At Hanover, where Leibnitz died, the occasion of the recent anniversary was marked by the opening to the public, for the first time, of the Chamber of Leibnitz, at the Royal Library. This room contains a crowd of objects which belonged to that philosopher—including many of his manuscripts, published and unpublished—his journal of the year 1696—his correspondence with the Duke of Hesse—the fauteuil in which he sat, and the book which he was reading, when struck by death. This book is the first volume of the works of Argenais de Barclai,—Amsterdam edition. M. Eccard, the pupil and friend of Leibnitz, has written in it, in Latin, the following note:—"The illustrious Leibnitz had in his hand, and was reading, this book, when, in the year 1716, the 14th day of November, an unexpected death overtook him. Witness, George Eccard."—The house in which Leibnitz lived, at Hanover, has been purchased by the Government,—and is to be called the *Leibnitz Museum*. There,

will be deposited all that may in future be collected relating to the deceased philosopher.

16. *Comet Medal*, (Athen., July 18, 1846.)—A letter from Prof. Schumacher, says, "The King of Denmark has offered the Comet Medal (20 Dutch ducats in gold) for the best discussion of Tycho's observations of the Comet of 1585. Prof. Gauss is appointed judge. The papers must be sent to me before July 1st, 1847, without name, distinguished by a motto only, and the name of the author in a sealed paper, inscribed with the same motto. You will find in No. 533 of the *Astronomische Nachrichten* all the information which can be required."

17. *Chinese Map*, (Athen., July 18, 1846.)—Amongst the articles brought from China by the Commission who have just returned from that country,—and which are exhibited at the Ministry of Commerce,—is a map of the world, presented to the Commission by the head Mandarin of Canton. The Chinese geographer has arranged the earth quite in his own way. With him, there are no isthmuses, no peninsulas; the Isthmus of Suez is replaced by a magnificent arm of the sea, which detaches itself from the Mediterranean to fall into the Red Sea. We see nothing of the Isthmus of Panama, and the two seas on that side are connected in the same way. There are neither Pyrenees nor Alps, and hardly are the vast mountains of America indicated. On the other hand, however, China is liberally dealt with by the geographer; for upon this point it occupies not less than three-quarters of the whole globe.—*Galignani.*

18. *M. Verneuil on the Fusulina in the Coal Formation of Ohio*, (in a letter to the editors of the Amer. Quart. Jour. of Agriculture, iv, 166.)—I have made in the carboniferous formations of Ohio a very interesting discovery for me, as a Russian traveler. The burrh stone, or mill stone of this country, is a siliceous band which occupies about the central part of the carboniferous series. This stone is full of small cavities, similar to the impression due to a grain of corn or wheat. These cavities, as I assured myself, have been filled by a small animal of the class of the Foraminifera, which Prof. Fischer has called in Russia, *Fusulina cylindrica.* You will easily understand the pleasure I felt to find my old traveling guide. In Russia, the Fusulina occupies principally the highest division of the carboniferous limestone, and here it is confined also to the coal series; but what is the most astonishing is, that in the old continent, the Fusulina is exclusively found in Russia, where it constitutes hills of two hundred feet, entirely composed of them. When you come to Germany or the British islands, the Fusulina is wanting; and so it had seemed to us that it was a being organized for eastern countries

19. *Dr. Owen's Report on the Mineral Lands of the United States.*—This important document, which has been for six years sleeping in the archives of the Treasury Department at Washington, has at last been brought out with all its maps, plates of fossils, and picturesque views. The ground covered by this report contains about 11,000 square miles, and the results possess a high interest, both in a practical and scientific point of view. The time in which this great labor was performed seems incredibly short, and the fact that the work *was* done, and well done, is sufficient proof, not only of Dr. Owen's great energy, forethought and tact, but of his thorough fitness for the task, by previously acquired knowledge. He thus alludes to his labors:

"After duly weighing the nature of my instructions, estimating the extent of country to be examined, considering the wild unsettled character of a portion of it, and the scanty accommodations it could afford to a numerous party, (which rendered necessary a carefully-calculated system of purveyance,) and ascertaining that the winter, in that northern region, commonly sets in with severity from the 10th to the middle of November, my first impression was, that the duty required of me was impracticable of completion within the given time, even with the liberal permission in regard to force accorded to me in my instructions. But, on a more careful review of the means thus placed at my disposal, I finally arrived at the conclusion, that, by using diligent exertion, assuming much responsibility, and incurring an expense which I was aware the department might possibly not have anticipated, I might, in strict accordance with my instructions, if favored by the weather and in other respects, succeed in completing the exploration in the required time.

"I therefore immediately commenced engaging sub-agents and assistants, and proceeded to St. Louis; there (at my own expense, to be repaid to me out of the *per diem* of the men employed) I laid in about three thousand dollars worth of provisions and camp furniture, including tents, which I caused to be made for the accommodation of the whole expedition; and in one month from the day on which I received my commission and instructions in Indiana, (to wit, on the 17th of September,) I had reached the mouth of Rock River; engaged one hundred and thirty-nine sub-agents and assistants; instructed my sub-agents in such elementary principles of geology as were necessary for the performance of the duties required of them; supplied them with simple mineralogical tests, with the application of which they were made acquainted; organized twenty-four working corps, furnished each with skeleton maps of the townships assigned to them for examination, and placed the whole at the points where their labors commenced, all along the southern line of the western half of the territory to be examined.

Thence the expedition proceeded northward, each corps being required, on the average, to overrun and examine thirty quarter sections daily, and to report to myself on fixed days at regularly appointed stations: to receive which reports, and to examine the country in person, I crossed the district under examination, in an oblique direction, eleven times in the course of the survey. Where appearances of particular interest presented themselves, I either diverged from my route, in order to bestow upon these a more minute and thorough examination; or, when time did not permit this, I instructed Dr. John Locke, of Cincinnati, (formerly of the geological corps of Ohio, and at present professor of chemistry in the medical college of Ohio,) whose valuable services I had been fortunate enough to engage on this expedition, to inspect these in my stead.

"By the 24th of October, the exploration of the Dubuque district was completed, and the special reports of all the townships therein were dispatched to your office, and to the office of the register at Dubuque. On the 14th of November, the survey of the Mineral Point district was in a similar manner brought to a close; and by the 24th of November, our labors finally terminated at Stephenson, in Illinois; the examinations of all the lands comprehended in my instructions having been completed in two months and six days from the date of our actual commencement in the field. Also several thousand specimens—some of rare beauty and interest—were collected, arranged and labelled.

"The weather was favorable, and the winter did not set in with severity until about a fortnight later than is usual in that latitude; yet, the same day on which the survey was completed, a severe snow-storm occurred, a gale blew up from the northwest, the thermometer fell to 12 or 14 degrees below zero, and the expedition could not have continued its operations in the field a single day longer.

"The district of territory explored lies nearly in equal portions on both sides of the Mississippi river, between latitude 41 and 43 degrees; commencing at the mouth of Rock river, and extending thence north, upwards of 100 miles, to the Wisconsin river, which discharges itself into the Mississippi immediately below Prairie du Chien.

"The average width of this body of land exceeds 100 miles. It comprehends about 11,000 square miles, equalling in extent the state of Maryland."

We cite from the report at the present time only the following general remarks:—

"The general geological character of the country explored may be thus briefly summed up. It belongs to that class of rocks called by recent geologists *secondary*, and by others occasionally included in the *transition* series. It belongs, further, to a division of this class of

rocks described in Europe as the mountain limestone, or sometimes as the carboniferous, or metalliferous, or encrinital limestone. And it belongs, yet more especially, to a subdivision of this group known popularly, where it occurs in the west, as the *cliff limestone*, and described under that name by the geologists of Ohio.

"This last is the rock formation in which the lead, copper, iron, and zinc of the region under consideration, are almost exclusively found; and its unusual development doubtless much conduces to the extraordinary mineral riches of this favored region. It therefore demands, and shall hereafter receive, particular analysis and attention.

"In the northern portion of the district surveyed, an interesting and somewhat uncommon feature in the geology of western America presents itself. I refer to the strata (of considerable depth) which crop out along a narrow strip of the northern boundary line of this district, and which are chiefly observable in the bluffs on both sides of the Wisconsin river; whence (if we may rely on the representations of Schoolcraft and others) they extend north, even to the falls of St. Anthony.

"These strata are interesting, first, as being the only instance known to me, in the valley of the Mississippi, in which the rocks underlying the blue limestone can be seen emerging from beneath it to the surface; and secondly, as apparently supplying an example of those alternations of neighboring strata, to which I have already alluded as being partial exceptions to the invariable order of geological superposition."

20. *Academy of Natural Sciences of Philadelphia.*—The usefulness of this institution, and the interests of science in general, have been greatly promoted by the munificent liberality of Dr. Thomas B. Wilson, a citizen of Philadelphia, and a member of the Academy. This gentleman has recently purchased, in Paris, the splendid collection of birds known as the *Rivoli Collection*; which is admitted to have few rivals, either in respect to the beauty or the variety of its specimens. The number exceeds 10,000, embracing 5,000 *species*, mounted and named, and illustrating all the diversities of plumage incident to the difference of age, sex and locality.

Dr. Wilson has not only become the proprietor of this remarkable collection; he has also resolved to place it in the Academy, where it will be accessible to the public, and thus diffuse the knowledge of one of the most pleasing branches of natural history. But the present Hall of the Academy, spacious as it is, is too small to accommodate this gigantic acquisition, and it therefore becomes necessary to extend the building, which can only be accomplished at a heavy expense. But Dr. Wilson, with a liberality that has few examples, has removed this obstacle, by authorizing the Academy to construct, at his sole expense, the requisite additions to the Hall, which are already in progress, and

are to be completed early in the coming year. The main saloon, by this arrangement, will be one hundred and fifteen feet long by forty-five feet broad, admirably lighted, and fire-proof throughout.

We record with pride and pleasure this noble contribution to the science of our country; and we may justly and emphatically apply to Dr. Wilson, a remark that was made of William Maclure, the venerable founder and benefactor of the Academy:—"It is rare that affluence, liberality, and the possession and the love of science, unite so signally in the same individual."*

Obituary.—*Denison Olmsted, Jr.*, died of consumption at New Haven, Conn., Aug. 15, 1846, aged 22 years. Mr. Olmsted was a son of high promise of Prof. Olmsted of Yale College. He had already distinguished himself as a mineralogist and chemist, and had displayed uncommon ability as an original investigator. His devotion to mineralogy commenced at a very early age, while yet a school boy; and when but nine years old, he had made great proficiency in mathematics. He had been for two years prior to his death, in the chemical laboratory of Yale College, where his services were highly valued, and several of his analytical results have appeared in former volumes of this Journal. For a year before his death he held the post of chemist in the geological survey of Vermont, and within a few months he had been honored with an appointment to a similar situation in Canada.

He died, as he had lived, a Christian; and although the hopes of many have been disappointed, friendship could desire no happier termination of his labors.

Bonpland, (Lond. Atheneum.)—M. Aimé Bonpland, the celebrated naturalist, and fellow traveler of Humboldt, recently died at Corrientes, where he had resided since his release from Paraguay, where he was long held a prisoner by Dr. Francia, the Dictator.

Benzenberg, (Lond. Atheneum.)—M. J. F. Benzenberg died in the spring of 1846, at Dusseldorff, aged 67 years. In conjunction with the late Prof. Brandes, he undertook near half a century since, in a systematic manner, the investigation of the orbits of shooting stars; and the various works and papers which since 1798 he has published on this subject, have obtained much celebrity. He has also contributed memoirs on mathematics, natural philosophy and mineralogy. He has bequeathed to the town of Dusseldorff, the observatory which he had built, his rich collection of astronomical and other philosophical instruments, and the sum of 7000 thalers, the interest of which is to keep the apparatus in repair.

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* Am. Jour. of Science, iii, 362.

Bibliography.

1. *A Treatise on Algebra;* by Elias Loomis, A. M., Professor of Mathematics and Natural Philosophy in the University of the City of New York, Member of the American Philosophical Society, of the American Academy of Arts and Sciences, &c. Harper & Brothers. 1846.

Many treatises on the elementary mathematics have recently appeared in this country. We are glad to see them. They indicate an increased attention among us to an important department of learning, and are, to a certain extent, demanded by the constant access of illustration which this department is receiving from the labors of European analysts.

In the work which Professor Loomis now submits to the public, he has aimed at exhibiting the first principles of Algebra in a form which, while level with the capacities of ordinary students and the present state of the science, is fitted to elicit that degree of effort which educational purposes require. We think he has been generally successful, and that the intrinsic merit of the work will concur with his official situation in securing to it the favorable attention of teachers.

The typographical execution of the work is good as far as page 192; where the type changes and becomes rather too small to suit a work designed for general use as a text-book. We have not found entire freedom from errors of the press, and it would be unreasonable to expect it. Throughout the work, whenever it can be done with advantage, the practice is followed of generalizing particular examples, or of extending a question proposed relative to a *particular* quantity, to the *class* of quantities to which it belongs: a practice of obvious utility as accustoming the student to pass from the particular to the general, the tendency to which constitutes the basis of the philosophic spirit and of all enlarged useful action,—and also as fitted to impress a main distinction between the Literal and Numeral Calculus, the superiority of the former as enabling us to treat of *classes* of quantities where we should otherwise be compelled to confine our view to individuals, and the immense assistance afforded by mere notation to the operations of the human intellect. The General Doctrine of Equations is expounded with clearness, and, we may add, with independence. The author has developed this subject in an order of his own; theorems which find a place in other treatises are omitted, and what sometimes appears in a generic form or in that of a corollary, becomes specific or assumes the place of a primary proposition. We venture to say that there will be but one opinion respecting the general character of the exposition.

2. *The Horticulturist;* by A. J. Downing.—The first number of this new monthly Journal was put on our table in July. It is devoted

to all horticultural and rural matters, architecture, and the literature of its own departments. The editor of this attractive Journal has earned a wide renown by his elegant and most useful works on Landscape Gardening, Cottage Architecture, and Pomology. As an original and accomplished author in these attractive and popular pursuits, he has no rival since the death of the indefatigable Loudon, and his merits have been acknowledged by marks of high consideration from some of the crowned heads of the old world. Under his conduct, and judging from the merits of the first number, the Horticulturist bids fair to run an useful and honorable course.

3. *M. D'Orbigny* has already brought out the first numbers of his new enterprize, as follows:—

(1.) *Paléontologie Universelle de Coquilles et de Mollusques, avec un Atlas représentant toutes les espèces de Coquilles Fossiles connues.* 1re livraison, 29 plates. Gide & Co., Rue de Petits-Augustines, 5.—This great systematic work is designed to contain all known species of fossil molluscs with a figure of each species. It will be completed in eight volumes of text, 8vo, with an atlas of about 1500 plates. Each livraison will contain 20 plates and the corresponding text, and costs 6 francs. Cost of the whole about 450 francs. This work will comprise all the plates of the "Paléontologie Française" of the same author, which has already reached 150 livraisons and about 600 plates, and is still in progress. In fact all that this voluminous author has done in these departments of Zoology, in his monograph of the Cephalopodes, his Geology of South America, his works on the Antilles, and numerous others, will be comprised in the Paléontologie Universelle. When finished, the Paléontologie Universelle will supersede all other systematic works in the department of geology which it covers.

(2.) *Mollusques Vivants et Fossiles, ou Description de toutes les espèces de Coquilles et de Mollusques classées suivant leur distribution Géologique et Géographique;* par Alcide D'Orbigny. 3 livraisons, with colored plates.—This work will form ten volumes in 8vo of text, with about 300 plates. It will appear in livraisons containing 5 plates and 5 folds of text, which will cost with uncolored plates each 3 fr. 50 c., and with colored plates 5 fr. The plates contain exquisitely engraved and colored figures of the typical species of each genus, as well as of those species which are most characteristic of each formation.

(3.) *Paléontologie des Coquilles et des Mollusques étrangers a la France;* par M. Alcide D'Orbigny.—This work is designed more particularly for circulation in France, and for those who have already possessed themselves of the *Paléontologie Française.* It contains only those plates which the last mentioned work does not, but the text of the Universal Paleontology complete.

We have received for distribution from the author, a supply of his prospectus with specimen plates, and also several copies of the first numbers of the two first mentioned works, as specimens of the style, and can supply all our friends who will make early application for them (post paid) to the address of B. Silliman, Jr. We have before mentioned that M. D'Orbigny, was desirous of procuring the works of all American writers on geology, and well labelled suits of fossils from our several formations. For these he will make an equivalent in any of his published works, or in French and Jurassic fossils. We trust that a number of subscribers to the Paléontologie Universelle will be found in this country, to aid in sustaining this Herculean enterprize. By the kindness of the author we have received a copy of several of his most important works, beside the foregoing.

4. *Leçons de Géologie Pratique, tome premier*, Paris, 1845, 8vo. —This volume comprises the first eleven lectures of the distinguished Elie de Beaumont, delivered at the college of France during the years 1843 and 1844. Several of the first lessons are devoted to preliminaries, descriptions of instruments, mode of observation, collection and preservation of specimens, &c. The lecturer commences with the loose material of the surface, the sands of the deserts and the sea. He then considers the phenomena of low lands in all parts of the globe, the mouths of rivers, and the great deltas of the Nile, Ganges, and Mississippi, with which the eleventh lecture closes. The work will be comprised in three similar volumes, of which the third is announced for August of this year.

5. *Works of M. Agassiz.*—We are favored with the continuation of several of the publications of this industrious author, whose works are not more numerous than they are excellent. We notice the following for the first time :—

(1.) *Matériaux pour servir* à une énumération aussi complète que possible des ouvrages publiés sur l'histoire naturelle, dès les temps les plus anciens jusqu' à ce jour, et que je me propose d'éditer plus tard sous le titre de *Bibliothèque Zoologique et Paléontologique.*

This is an alphabetical list, in folio, of authors and works, in all departments of zoology, general and comparative anatomy, physiology, the study of fossils, geology, all memoirs on chemistry and physique, which have any bearing on physiology or relate to the structure of the globe.

The sheets now issued of this gigantic undertaking are 282 in number, forming a ponderous folio, with a single column of letter press and a wide margin for additions. This issue is distributed by the author to those who will aid him in endeavoring to fill up and complete this great and most important labor. The intention is ultimately to issue a complete conspectus of the literature of the whole world in these departments of science. What is already done must be of infinite service to

naturalists, and the coöperation of all is invited in endeavoring to render these lists as complete as possible.

(2.) *Iconographie des Coquilles Tertiaires*, 4to, 1845.—This memoir is devoted to the descriptions and figures of those tertiary fossils which are reported to be identical with living species, or with those in different strata of this epoch.

This memoir contains fourteen plates and twenty-eight species belonging to the four genera *Cytherea*, *Cyprina*, *Venus*, and *Lucina*.

(3.) *Notice sur la Successions des Poissons Fossiles;* folio.—This is an extract from the last livraison of the *Poissons Fossiles*, giving an account of the position of fossil fish in the series of geological formations. Also an essay on the classification of fishes.

(4.) *Tableau Général des Poissons Fossiles rangés par terraines*, par L. Agassiz.—This thin quarto (only 16 pp.) is a most important item to all students in this department, being a well arranged catalogue of all species of fossil fish known in 1844.

(5.) *Monographie des Poissons Fossiles du Vieux Grès Rouge.* (Old red sandstone) des iles Britanniques et de Russie, par L. Agassiz. Three parts of text in 4to, and three folio atlases of plates.—This work was undertaken at the request of the British Association at the Manchester meeting in 1842. Those who have followed Hugh Millar in his delightful wanderings "in an old field," will here recognize the grotesque forms and uncouth portraits of those progenitors of the finny tribes which characterize the "Devonian System." The work surpasses even the Poissons Fossiles in the splendor of its illustrations.

(6.) *Etude Critique sur les Mollusques Fossiles*, par L. Agassiz, 3 and 4 livraisons.—The former parts of this monograph we have already noticed. These two livraisons complete the genus *Mya* in 95 plates 4to, and accompanied by full descriptions.

(7.) *Nomenclator Zoologicus*, continens nomina systematica generum animalium tam viventium quam fossilium; auctor L. Agassiz.—We have already noticed* somewhat at length, in connection with the report of the British Association on the subject of nomenclature, this important labor of the Swiss naturalist.

The fasciculi vii. and viii. contain chiefly the Pisces and Hymenoptera, with additions to several of the previous families. The work will be complete in 12 fasciculi, and published without delay. It will when complete contain 31,000 names without the synonyms, each order being distinctly and separately paged and alphabetized. There will also be a full index to the whole work.

6. *Kunze's Supplement to Schkuhr's Carices;* part iv, contains figures and full descriptions of the following species, viz:—C. gynocrates,

* This Journal, 1st Series, xlv, 1.

Wormsk; C. Redouskiana, *Meyer;* C. crus-corvi, *Shuttlew.* Mss.; C. disperma, *Dewey;* C. Hochstetteriana, *Gay;* C. planostachys, *Gay;* C. Mairii, *Coss.* and *Germ.;* C. macrolepis, *D C.;* C. Durieui, *Steud.;* C. lucorum, *Willd.;* C. subulata, *Michx.;* of which the first is a native of the Arctic regions, and five others belong to the United States. The *C. crus-corvi* (from New Orleans, Drummond) is the same as the C. sicæformis of Boott, in the Journal of the Boston Natural History Society for January, 1845; we are uncertain which name has the priority. C. disperma is figured from specimens collected by Rugel in the mountains of Carolina; as also is C. lucorum, *Willd.*, which appears like a common state of C. Pennsylvanica. C. subulata is well represented, we believe from New Jersey specimens, communicated by Dr. Knieskern. A. Gr.

7. Drejer, *Symbolæ Caricologiæ Synonymiam Caricum extricandam stabiliendamque et affinitates naturales eruendas. Adjectæ sunt tabulæ æneæ XVII*, (Opus Posthumum ab Scient. Danica Soc. editum, pp. 40, imp. 4to, 1844.)—The late S. Drejer, of Copenhagen, author of the *Revisio Critica Caricum Borealium, etc.*, 1841, died just as he was rising into high reputation as a Caricologist, and while preparing more extended works upon his favorite genus. This posthumous production was doubtless intended as merely the first of a considerable series. Several interesting North American species are admirably represented in the plates, and of the natural size, viz. Carex Shortiana, *Dew.*, C. glaucescens, *Ell.*, C. Cherokeensis, *Schwein.*, C. stenolepis, *Torr.*, and C. squarrosa, *Linn.* We are glad to learn that the C. stenolepis of Torrey is to retain its name, the earlier homonym of Lessing being, as Drejer asserts, only a boreal and depauperate form of C. vesicaria. The introduction contains some good observations on the natural grouping of Carices, illustrated by three elaborate engraved tables.

A. Gr.

LIST OF WORKS.

Memoirs of the Geological Survey of Great Britain, and of the Museum of Economic Geology in London, vol. i, roy. 8vo, with wood cuts and 9 large plates. 1846, *London.* 21*s.*

Botanical Chart of British Flowering Plants and Ferns, by H. F. Knapp. 8vo. *London*, 7*s.* 6*d.* cl.

Nomenclature of Colors, by D. R. Hay, 2d edit. 4to. *London*, 1846. 35*s.* cl.

Bibliotheca Historico-naturalis, (containing a notice of the works on Natural History published in different parts of Europe during the past century, and ending with the middle of 1845,) by Wm. Engelmann. *Leipzig*, 1846.

Iconographie Ornithologique, (in illustration of the Buffon Series,) by Friedrich Klincksieck, Paris. Is issued in parts, in folio with 6 colored sheets, and also in quarto.

Handbuch der Mineralogie, A. Herr, Professor at Wetzlar. 8vo, *Frankfurt* bei Sauerländer.

Giornale toscano di Scienze mediche, fisiche, e naturali, diretto dai Professori G. B. Amici, Matteucci, Puccinnotti, G. Paolo Savi, *Pisa*.

Lehrbuch der Zoologie, Dr. A. Berthold. 8vo, 592 pp., 1845, *Göttingen*.

Lehrbuch der Vergleichenden Anatomie, von Pr. v. Siebold und Pr. Stannius, 1 heft, 1845, *Berlin*.

Phycologia Germanica, by Prof. Fr. Phil. Kützing. 8vo, 240 pp., 1845: *Nordhausen* bei Köhne.

Giornale botanico Italiano, compilato per cura della Sezione Botanica dei Congressi Scientifici Italiani du Filippo Palatore, *Firenze*. 1845.

Elmintografia umana, by S. delle Chiaje. 8vo, 264 pp. 1844, *Napoli*.

Systematische Uebersicht der Vögel Nordost-Africas von Dr. Rüppell; large 8vo, 144 pp, 50 pl., 1845. *Frankfurt*, bey Schmerber.

Atlas de Cranioscopie, ou dessins figuratifs de Crânes et de faces de personages célèbres ou remarquables, by Dr. C. G. Carus; (also in German.) *Leipzig*, 1845.

Petrefaktenkunde Deutschlands, by Prof. F. A. Quenstedt. Large 8vo, *Tubingen*, 1846.

Ueber einige bömische Trilobiten, by Dr. Ernst Beyrich. Large 4to, *Berlin*, 1845.

SCIENTIFIC RESEARCHES.

Proceedings of the Academy of Natural Sciences of Philadelphia; May, 1846. Page 51. Two new species of Echinodermata from the Eocene of the United States; S. G. Morton.*—Page 52. New species of Bat from Western Africa; E. Hallowell.†—Page 53. New Coleoptera of the United States; F. E. Melsheimer. (Genera—Cantharis, Zonitis, Nemognatha, Ischnomera, Nacerda, Xylophilus, Melandrya, Hypulus, Seraptia, Hallomenus, Orchesia, Eustrophus, Eryx, Allecula, Mycetocharus, Cistela, Helops, Trachyscelis, Neomida, Platydema, Hypophœus, Uloma, Iphthinus, Blapstinus.)—Page 66. A new Physa, and remarks on Glanderia cylindracea; J. S. Phillips ——*June*, 1846. Page 72. Anatomy of the abdominal viscera of the Sloth (Bradypus tridactylus); J. Leidy.—Description of Unio abacoides; S. S. Haldeman.‡

Proceedings of the Boston Society of Natural History, July, 1846.—Page 121. Analysis of the glassy scoria of Kilauea; J. Peabody.—Page 123. Notice of the deposits on the Chatahoochie River, Georgia; J. H. Couper.—Page 124. On the trap and sandstone of the southern shore of Lake Superior; H. D. Rogers.—Page 126. On the Natchez Bluffs; A. Binney.—Page 131. Drift on the Hill called Mount Washington, at South Boston; C. Stodder.—Page 132. Remarks on the Mollusca of Jamaica; C. B. Adams.

Proceedings of the Providence Franklin Society, vol. i, No. 1. Catalogue of Rhode Island plants; S. T. Olney.

Annals and Magazine of Natural History, June, 1846, No. 114. Natural History of the Malayan Archipelago, by P. J. Begbie, noticed at length by H. E. Strickland.—New Entomostraca, with a plate; W. Baird.—Corynactis, a new genus of Helianthoid Zoophytes, with a plate; G. J. Allman.—Zool. Soc. Proceedings, Nov. 25, 1845. New Helices from the collection of H. Cuming; Dr L. Pfeiffer.—Dec. 9, New Land Shells from Jamaica; Dr. L. Pfeiffer.——*July*, *No.* 115. *Proceedings Zool. Soc.*, Jan. 13, 1846. A new Nyctibius; Mr. Gould.—Jan. 27, Dissection of the Chimpanzee, R. Owen.—New species of Pleurotoma from various regions; L. Reeve.—Feb. 24, Osteology of the Active Gibbon, Hylobates agilis; E. Fry.—Eleven new Australian Birds; J. Gould.——*July*, *No.* 116. On

* See this Number, p. 273. † Ibid. ‡ Ibid., p. 274.

the circulation of the sap in the interior of cells; H. von Mohl.—On the cell membrane of plants; G. H. K. Thwaites.—New Orthopterous and Homopterous Insects, with a plate; Adam White.—On certain genera of Shells of the class Palliobranchiata, (Terebratulæ, &c.); W. King.—Four new Longicorn Beetles, with a plate; A. White.—Descriptions of the Mymeridæ; F. Walker.—A new family and genus of Lizards from Columbia; J. E. Gray.—*Zoological Society*, March 10. New species of Cypræa; L. Reeve.—March 24, Size of Blood Corpuscles in Birds; Mr. Gulliver.—Thirty new Helices, belonging to the collection of H. Cuming; L. Pfeiffer.

Hooker's London Journal of Botany, for June, 1846. New Hepaticæ; Th. Taylor.—New genus of Hydrophyllaceæ from California; Dr. Harvey.—Notes on a Journey in the interior of Southern Africa; Ch. L. Zeyher.

Annales des Sciences Naturelles, *for January*, 1846. *Zoology.* Description of the galls of Verbascum and Scrophularia, and the insects which inhabit them; Leon Dufour.—On the apparatus of respiration of Birds; Natalis Guillot. *Botany.* On a new genus of Cycadeæ of Mexico; Ad. Brongniart.—Note of Dutrochet relative to objections brought by Trecul against his opinion respecting the development of adventitious roots.—On the structure of old trunks of Cycas circinalis; M. Miguel.—On stems which descend towards the earth like roots; M. Dutrochet.—On a new genus of Paronchieæ, Dicheranthus; P. Barker Webb.—Revision of the genus Poterium; Edw. Spach.—Twelfth notice on the Cryptogamic plants of France; M. Desmarières.—Memoir on the relations of Noggerathia to living plants; Ad. Brongniart.—Monstrosities of Antirrhinum majus and other plants, by Mélicocq.

Societe Philomatique de Paris. Session of May 9, 1846. Sur l'organization des Vers; M. Blanchard, (L'Institut, No. 645, p. 163, and No. 646, p. 172.)

Memoires de la Soc. Roy des Sciences de Liege, tome i, part 1, 1843. Page 85. Review of the species of Cicindelæ, with descriptions of some new species; Th. Lacordaire. Tome ii, part 2, 1844. Page 261. Two new Bulimi from Columbia; H. Nist.

Academie der Wissenschaften zu Berlin. Session of Nov., 1845. On the microscopic life of Portugal, Spain, South Africa, Lower India, Japan and Kurdistan.——March, 1846. On the structure of the Ganoid fishes; Hr. Müller.—On the uncrystalline silica in plants, and a Spongilla in Silesia, and their relation to the infusorial earth of Berlin deposits; Hr. Ehrenberg.—Note on the Spirifera and Terebratula; von Buch.

Akademie der Wissenschaften zu Göttingen. Session of Aug. 2, 1845. On new or rare reptiles of New Grenada, and on the Crustacea of China; M. Berthold, (L'Institut, No. 644, 1846, p. 156.)——Feb. 11, 1846, on three new Scorpions from New Grenada.

Isis, (Leipzig,) No. 2, 1846. Page 127, 133. New Caprellina, with plates, (from Kroyer's Zeitschrift, iv, heft 5, 1843.) Nos. 3 and 4, 1846. On the habitats, or mode of life, of Diptera; M. Bremi.—Lepidopterological Fauna of Lievland and Gurland; F. Lienig and P. G. Zeller.

Archiv fur Naturgeschichte, No. 1, 1846. On some imperfectly known Annelida; E. Grube.—New genus of Holothuria; F. H. Troschel.—Clepsina costata, a new species; F. Müller.—Review of the species of the genus Astacus; W. F. Erichson.—A Delphinus found near Messina.—On the Geographical Zoology of the Islands of the Indian Archipelago; Dr. Sal. Müller.